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NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

CONDUCT AND ASSESSMENT OF A2C2 EXPERIMENT 9 AND IDEAS TO CONSIDER FOR FUTURE EXPLORATION

by

Nelson D. Heintz
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June 2004

Thesis Advisor: William G. Kemple
Second Reader: Susan G. Hutchins

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The ability of an organization to adapt its structure to changing dynamic requirements can provide for increased effectiveness and efficiency. A better understanding of the factors that affect adaptation capabilities within an organization can facilitate implementation of changes to better fit the organization to the mission.

Experiment 9, conducted for the Office of Naval Research's (ONR) Adaptive Architecture for Command and Control (A2C2) research program, provided insight into the decision making process of a small group given changes in a scenario to prompt the need for change. The experiment also provided insight into the challenges faced by an organization in the process of adaptation, and factors that affect the willingness and need for adaptation.

This thesis examines how differences of emphasis within the training environment itself may affect an organization's willingness to adapt to changing circumstances. This thesis proposes changes to future experiments, focusing efforts on making cues more apparent to the test subject. This thesis also suggests modifications to the data collection system to enhance post experiment analysis.

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CONDUCT AND ASSESSMENT OF A2C2 EXPERIMENT 9 AND IDEAS TO CONSIDER FOR FUTURE EXPLORATION

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The ability of an organization to adapt its structure to changing dynamic requirements can provide for increased effectiveness and efficiency. A better understanding of the factors that affect adaptation capabilities within an organization can facilitate implementation of changes to better fit the organization to the mission.

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This thesis examines how differences of emphasis within the training environment itself may affect an organization's willingness to adapt to changing circumstances. This thesis proposes changes to future experiments, focusing efforts on making cues more apparent to the test subject. This thesis also suggests modifications to the data collection system to enhance post experiment analysis.

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I. INTRODUCTION

A. ADVANCED ARCHITECHURES FOR COMMAND AND CONTROL (A2C2) BACKGROUND

Adaptive Architectures for Command and Control (A2C2) is an Office of Naval Research (ONR) sponsored research program to focus on key issues in Joint Command and Control (C2) and develop and test theories of adaptive architectures. More specifically, it focuses on C2 operational team planning and decision making at the Joint Task Force level. Additionally, the program seeks to investigate the underlying properties of architectures, develop analysis tools for organizations, formulate measures of merit, design "optimal" architectures, and discover drivers and forms of adaptation. The motivation for the program sprang from advances in technology which will allow for an information-rich decision environment. Command and control architectures with a network-centric infrastructure have the potential to be more agile and adaptive. The program seeks to consolidate knowledge gleaned from field observations and research in organization theory, team adaptation, and distributed simulations.

The adaptation that is being investigated is the modification of structures and/or processes in response to evolving circumstances. Adaptation can occur at the individual, team, or organizational level. The A2C2 program takes an interdisciplinary approach to the problem through a combination of theoretical, experimental, and field research conducted by a consortium of academic institutions, military organizations, and private companies. The research includes modeling of teams and organizations, formulating and exploring variables of organization structure, studying the properties and processes of organization change and adaptation, and developing metrics for and measuring team performance. The Naval Postgraduate School's particular focus with respect to the A2C2 program is human-in-the-loop experimentation in a simulated operational combat environment with military officers as participants. The latest series of experiments emphasized isolating salient cues and triggers for adaptation and the degree of congruence between an organization and its mission.

The program has evolved iteratively. Theory and model development shape human-in-the-loop experimental design. Experimentation validates the models and theories or refutes or modifies them and points the way to improving the entire process.

B. PURPOSE OF EXPERIMENT 9

A2C2 Experiment 8 was used to develop and validate two scenarios designed to be optimized for either divisionally or functionally structured teams in the Dynamic Distributed Decision-making III (DDD-III) simulator. The scenarios were "reverse-engineered" for this purpose, with an emphasis on resource requirements, inter-task coordination, and spatial-temporal loading. These emphasis areas were, by design, aspects of the scenarios which made one of two team structures (either divisional or functional) fit, or "congruent," and the other team structure "incongruent." Experiment 8 showed that there was a definite performance decrement when the team organization was "incongruent" to the mission scenario.

With the performance relationship between the scenarios and "optimal" structures firmly established, the intention of Experiment 9 was to follow up on these findings and further investigate the processes teams used to address the performance decrement due to incongruence between structure and mission, if participants were aware of this performance decrement at all. If the participants were aware of this performance decrement, could they identify the factors that caused it, would they attribute it to incongruence, and could they identify the sources of incongruence? What do participants do to address this decrement if they are aware of it: Do they adapt their team structure, or do they try to muddle through?

1. Real World Motivation

In the real world, organizations are not always well suited to their mission. The 'fit' between the organization and mission is difficult to determine, and even more difficult to measure. As conditions and requirements change, organizations may or may

not change to adapt. The standing Joint Task Force concept would benefit from insight into whether one structure or another predisposes organizations to lesser or greater adaptability. This iteration in the A2C2 series of experiments seeks to clarify what environmental factors and cues might lead to recognition of the need for organizational adaptation.

2. Experimental Questions

In A2C2 Experiment 9, the cues presented to prompt for organizational change included an organization theory brief, intelligence briefings, briefs showing team performance and other metrics, and an incongruent (incongruent with the team's current organization) mission scenario. The experiment sought to observe the degree to which teams recognized that their organization was not optimal for their upcoming mission, the adaptation that took place, and the reasons that motivated change. The experiment also sought to determine whether the different structures (i.e., functional and divisional) predispose teams to different perceptions of similar environmental cues or whether individual player proficiencies dominate adaptation decisions in small teams. Finally, would teams approach the scenario play sessions with the same strategies they developed in the prior planning sessions?

3. Experimental Approach

Experiment teams were organized in either a functional or divisional structure and engaged in a military scenario which was congruent (well suited) to their organization. The team was then given a briefing on organization design, followed by an intelligence update introducing new threats in the scenario. They were then given an opportunity to change their organization. After one iteration with this increased workload, the team was given another intelligence brief suggesting that the enemy has adapted their tactics to the team’s current organizational design. The team was given another opportunity to adapt their organization to the upcoming mission, which had been deliberately designed to be

difficult to prosecute in the organization in which they originally started. After this first incongruent scenario play, the team was given another opportunity to plan for the final (incongruent) scenario play session. After the last scenario play session, a final debrief with the team was conducted.

Five teams of six military officers were brought together from two classes in the Information Sciences Department at Naval Postgraduate School. Three teams were initially organized in a divisional structure and two teams were initially organized in a functional structure.

4. Anticipated Results

Based on previous experiments in the A2C2 research program, teams originally organized along functional lines are expected to be more resistant to change than those originally organized along divisional (Hollenbeck et al). Divisionally organized teams are more inclined to adapt to the changed scenario, since individual participants are more adept with, and more comfortable with a wider array of assets. Teams that do adapt their organizations will adapt them in a manner that reduces coordination requirements between individuals, levels out workload imbalances between players, and levels out the relative levels of asset utilization by the players.

5. Scope of Experiment

The focus of this experiment was primarily to observe the planning processes and the reasoning behind team adaptation decisions, in response to the cues introduced to stimulate adaptation, such as an intelligence briefing and performance feedback, especially as related to reallocation of resources between team members. Other focus areas included workload, perceived workload, performance, and perceived performance.

The A2C2 research team was supported in Experiment 9 by a Lead Team composed of NPS Joint C4I students who test ran the schedule of events and

experimental scenarios and then assisted in data collection during the conduct of the two-week experiment. The Lead Team members acted as observers, with their primary focus on recording the major themes that came up during the planning sessions.

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II. EXPERIMENT 9

A. DESIGN

1. Overview

A2C2 Experiment 9 was a collaborative effort by researchers from the Naval Postgraduate School, Aptima Inc., and the University of Connecticut, sponsored by the Office of Naval Research's Adaptive Architectures for Command and Control research program. This particular iteration of the A2C2 series of experiments examined the relationship between organizational structures and participants' perceptions of salient cues regarding the need for structural adaptation. The specific questions the A2C2 research team sought to answer were: Will teams or individual participants recognize when performance decrements occur and interpret these decrements as a salient cue to adapt incongruent structures? If teams do recognize those salient cues to structural incongruence, will they be willing to adapt their organization? How will teams adapt, and what cues will be the primary drivers of change?

This chapter describes the setup, design, instrumentation, pilot trials, experiment execution, and post-experiment data analysis of Experiment 9. It includes preliminary conclusions and lessons learned from this experiment that may be applied to future iterations of the experiment series.

2. Setup

A2C2 Experiment 9 was conducted in the Naval Postgraduate School's Secure Technology Battle Lab using the Distributed Dynamic Decision-making III simulator with teams composed of participants drawn from two NPS classes in the Information Sciences Department. Teams were brought into the laboratory for four sessions conducted over the course of two weeks.

a. Physical

The DDD-III team-in-the-loop simulator is a military operational simulator that was designed to study team and organizational dynamics (Pasaraba, 2000). In Experiment 9, DDD-III was run on eight workstations, six of which were utilized by the participants. A master workstation served as the control station and collected the experimental data for post-experiment analysis. The last workstation was used to display the common operational picture on a large screen in a separate room for the A2C2 researchers in real time. The physical layout for Experiment 9 is shown in Figure 1.

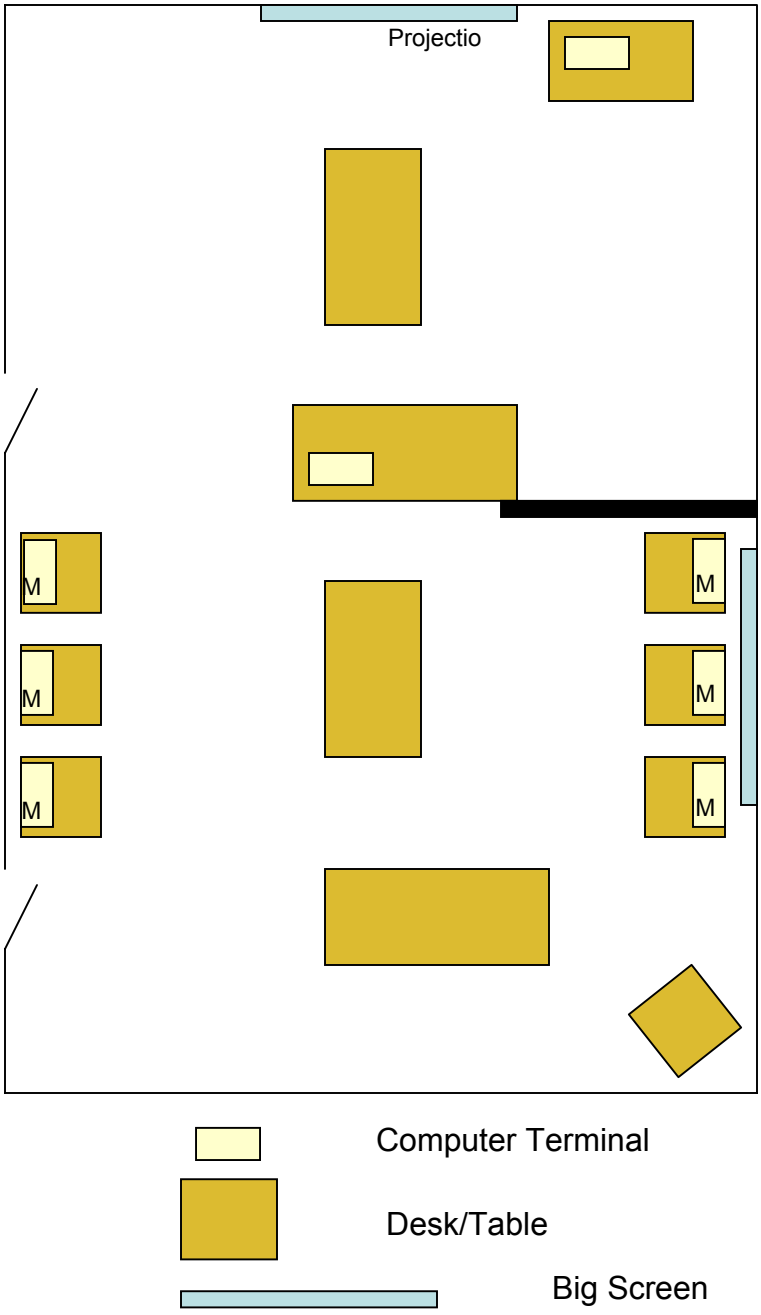


Figure 1. Physical Layout used during A2C2 Experiment 9

The six participants were linked to a broadcast voice net through headsets and microphones. Although the physical equipment allowed for two channels, they were cross-connected in this experiment, the participants did not have a choice to go to an alternate voice channel, in an attempt to create a network-centric access to all other players and all the information. All voice communications from both planning sessions

and scenario play sessions were recorded on audio cassette tapes by a recorder connected to the broadcast voice net for post-experiment analysis.

The visual display that the DDD-III simulator presented to the individual participants offered a common operational picture to each participant, but also allowed the individual participants to zoom in or out to an area of interest. The DDD-III also displayed threat alerts tailored to the individual participant's nominal platform association.

b. Participants

The participants consisted of 30 mid-grade military officers from different services, and in some cases different countries. Experience levels varied greatly; participants included some officers who just received their commissions to some officers who had decades of experience, including prior enlisted experience. Some officers had experiences at higher echelon staff positions while others had most of their experiences at tactical operational commands. Military occupational specialties varied greatly, from warfare specialists to staff officers. All officers were drawn from two classes in the Information Systems Department of NPS. They were divided into five teams of six participants each, organized in two different organizational structures.

c. Special Equipment

The Distributed Dynamic Decision-making III simulation software is the third iteration of a program initially developed by Dr. David Kleinman at the University of Connecticut (Pasaraba, 2000). DDD-III was jointly developed by both University of Connecticut and by Aptima, Inc. to support the human-in-the-loop laboratory experimentation portion of the A2C2 program. DDD-III recorded the task execution of the individual participants while an audio tape recorder recorded voice communications between the participants. The voice net was also connected to a speaker and several headphones in a separate room to allow researchers to monitor communications in real

time and tally and code them. A separate projector display allowed researchers to monitor scenario play in another room.

d. Schedule of Trials

A Lead Team composed of six mid-grade US Navy and Marine Corps officers conducted a series of pilot trials prior to the start of the experiment. Pilot trials took place from 16-27 February 2004, the two weeks prior to the start of the actual experiment. The experiment itself was conducted from 1-12 March 2004. Three teams of participants participated in the experiment during the first week and two teams participated in the experiment during the second week.

Teams were brought into the lab in four sessions over the course of three or four separate days. During the first two sessions, participants were trained to use the simulation and how to execute the mission tasking required in the upcoming scenarios. At the beginning of the third session, the team was given an organization table which shows the resource allocation for their team, a role sheet for each participant which explains their individual roles, and a task graph which delineates resource requirements for mission accomplishment of the military operational scenario. Tables and forms given to divisionally and functionally organized teams are included in Appendix A. They were then exposed to their first experimental scenario play, which was designed to be congruent with the organizational structure to which they had been assigned, but which also included a threat which they were not able to counter (SCUD missiles). The SCUD missiles appeared toward the end of the scenario play session and were intended as a lead-in to the introduction of new assets and the additional threat in the following scenario play session.

After the first scenario play, the team was briefed on organizational design and given a threat update brief. This is followed by a facilitated planning session. During the planning session, the team was given new resources to counter an emergent SCUD threat, asked to allocate these new resources, asked to update their roles and responsibilities, make any changes they feel would improve their organization, and asked

to plan for the next scenario play. Their changes are implemented in the DDD-III scenario definition file. The team was then exposed to its second scenario play with the new resources which they had distributed in their planning session. After this second scenario play, the team was given another threat update brief in which it was explained to them that the opposing forces had adapted to the team's organization and method of operation. The participants were instructed to keep this in mind and bring ideas for resource allocation to the next session.

In the final session the team was given the new task sheet and directed to plan for the upcoming scenario (which had been deliberately designed to require much greater coordination between individual participants, that is, they were organizationally incongruent for the mission). Their revised organization was then implemented and the team was then engaged in the incongruent scenario. After the scenario, the team was debriefed on their performance relative to the performance of an "optimally" designed organization, self-reported levels of workload for each team member, cognitive workload as modeled by a Carnegie Mellon University research program, and voice communications traffic. The team was then asked to conduct a post mission analysis and recommend further changes to their team's organization.

e. Scenario Descriptions

The general scenario involves a hostile Country A invading a friendly Country B, requiring friendly force intervention. A third Country C is nominally neutral in the conflict. Islands D and E require friendly force protection. Figure 2 depicts the map displayed to the subjects on the DDD simulator, showing the different countries, and high level assets/targets. The participants are put in command of a Joint Task Force consisting of assets based both at sea and on land.

Major platforms at sea consist of an aircraft carrier, three destroyers, a cruiser, and a frigate. The one land base is an air operations facility located on Island E. These major platforms cannot be moved from fixed locations, but sub-platforms (eg. Aircraft, helicopters, and missiles) may be launched from them. The team of participants

must capture or destroy seven major land objectives held by Country A in order to complete the mission; objectives had to be completed in a certain sequence, and the participants were given precedence task graphs to guide them. Figure 3 depicts the mission tasking presented to all teams (specific scenario task graphs contain additional information concerning attack requirements). In addition to this offensive tasking, the team must also defend its own forces from enemy attack and defend Islands D and E from attack by Country A.

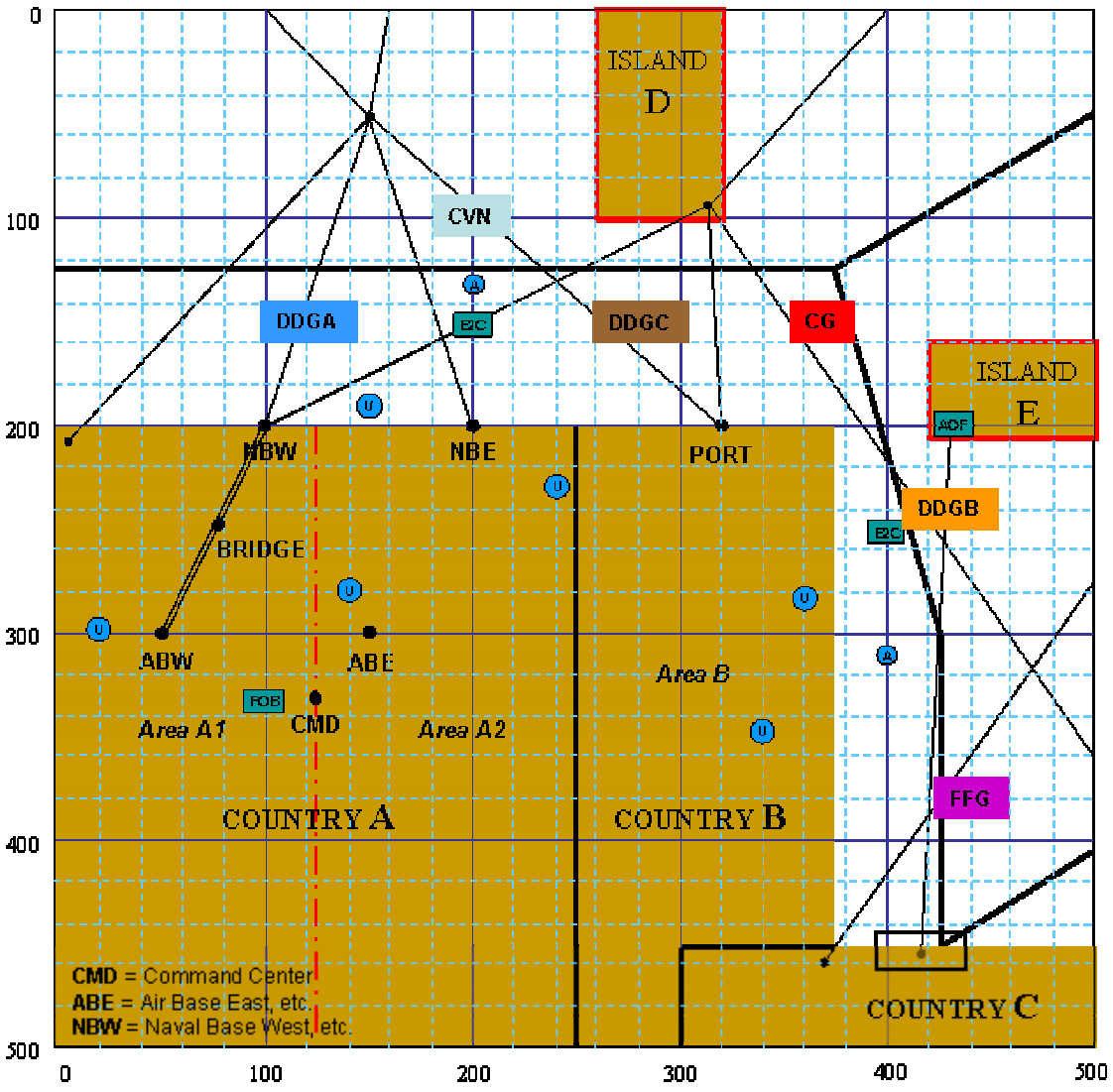


Figure 2. DDD Simulator Map (From A2C2 Experiment 9)

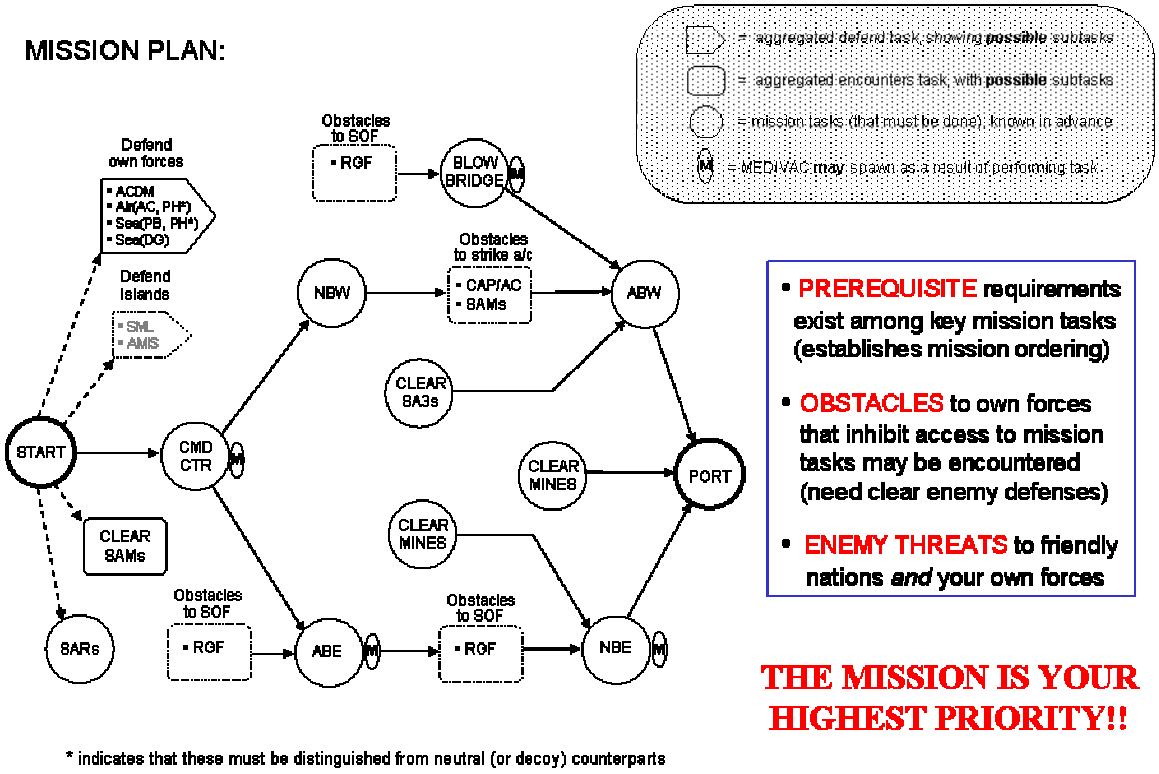


Figure 3. Task Graph – Fundamental (From A2C2 Experiment 9)

The five teams were initially organized into two very different organizational structures. Three teams, designated Teams A, C, and E, were placed in a divisionally organized structure (D teams); team players were given a variety of assets with various capabilities and were primarily divided along geographic lines. Two teams, designated Teams B and D, were placed in a functionally organized structure (F teams); team players were given one or two types of assets with limited capabilities but had responsibility for the entire area of interest to the Joint Task Force as a whole. The individual team members were labeled with colors (Blue, Brown, Purple, Green, Orange and Red) instead of traditional task force titles (e.g., Air Warfare Commander, Special Operations Commander, and Surface Warfare Commander) to minimize migration of the organization to predisposed structures based on participants' previous experiences in other settings. In teams that start in a divisional organization, the positions are generally based on geographical locations of non-movable assets: Blue – DDGA, Brown – DDGC, Orange – DDGB, Green – CVN, Purple – FFG, and Red – CG; initial asset distribution is

as shown in Figure 4. More detailed initial roles and responsibilities are in Appendix A, under Roles and Responsibilities for Commanders in Divisional Organizations. In teams that start in a functional organization, the positions are generally based on functional responsibilities: Blue – Search and Rescue (SAR), Brown – SOF (Special Operations Forces), Orange – Surface Warfare Commander(SuWC)/Mines, Green – Strike Commander, Purple – Intelligence Surveillance and Reconnaissance (ISR), and Red – Air Warfare Commander (AWC); initial asset distribution is as shown in Figure 5. More detailed initial roles and responsibilities are in Appendix A, under Roles and Responsibilities for Commanders in Functional Organizations.

DIVISIONAL ORGANIZATION - ASSET OWNERSHIP TABLE

		CVN	DDGA	CG	DDGC	FFG	DDGB	AOF	FOB
1	GREEN (on CVN)	F18S(a), F18S(b) UAV, HH60 FAB, MH53 F18A(a)+E2C F18A(b)							
2	BLUE (on DDGA)		UAV, HH60 FAB, 2HARP 8TLAM 6SM2						SOF(a)
4	RED (on CG)			8TLAM UAV, HH60 FAB, 2HARP, MH53 6SM2					
6	BROWN (on DDGC)				UAV, HH60 FAB, 2HARP 8TLAM 6SM2				SOF(c)
3	PURPLE (on FFG)					UAV, HH60 FAB, 2HARP, MH53 4SM2		F18S(a), F18S(b) F18A(a)+E2C F18A(b)	
5	ORANGE (on DDGB)						UAV, HH60 FAB, 2HARP 8TLAM 6SM2		SOF(b)
		CVN	DDGA	CG	DDGC	FFG	DDGB	AOF	FOB

Figure 4. Initial Divisional Organization

FUNCTIONAL ORGANIZATION - ASSET OWNERSHIP TABLE

		CVN	DDGA	CG	DDGC	FFG	DDGB	AOF	FOB
1	GREEN (on CVN)	F18S(a), F18S(b)	8TLAM	8TLAM	8TLAM		8TLAM	F18S(a), F18S(b)	
2	BLUE (on DDGA)	HH60	HH60	HH60	HH60	HH60	HH60		
4	RED (on CG)	F18A(a)+E2C F18A(b)	6SM2	6SM2	6SM2	4SM2	6SM2	F18A(a)+E2C F18A(b)	
6	BROWN (on DDGC)								SOF(a) SOF(b) SOF(c)
3	PURPLE (on FFG)	UAV	UAV	UAV	UAV	UAV	UAV		
5	ORANGE (on DDGB)	FAB, MH53	FAB, 2HARP	FAB, 2HARP, MH53	FAB, 2HARP	FAB, 2HARP, MH53	FAB, 2HARP		
		CVN	DDGA	CG	DDGC	FFG	DDGB	AOF	FOB

Figure 5. Initial Functional Organization

Two series of scenarios were developed for each of the two organizational structures; a series of scenarios was designed to be "congruent" with the divisionally organized teams (d scenarios) and a series of scenarios was designed to be "congruent" with functionally organized teams (f scenarios). Figure 6 shows the task graph for the functional scenario and Figure 7 shows the task graph for the divisional scenario, the asset dependencies for different tasks was based on scenario design. The teams were exposed to a congruent scenario in their initial play (Play #0), with a very limited number of SCUDs later in the scenario, and no ability to respond to them, a congruent scenario in their second play (Play #1), with a large number of SCUDs, and Tactical Tomahawks (TTOMs) and Anti-Ballistic Missiles (ABMs) to respond to them, and an incongruent scenario in their last play (Play #2), which was the scenario their other organizational structure counterparts played in Play #1. This made for a total of four scenarios used in the data collection runs.

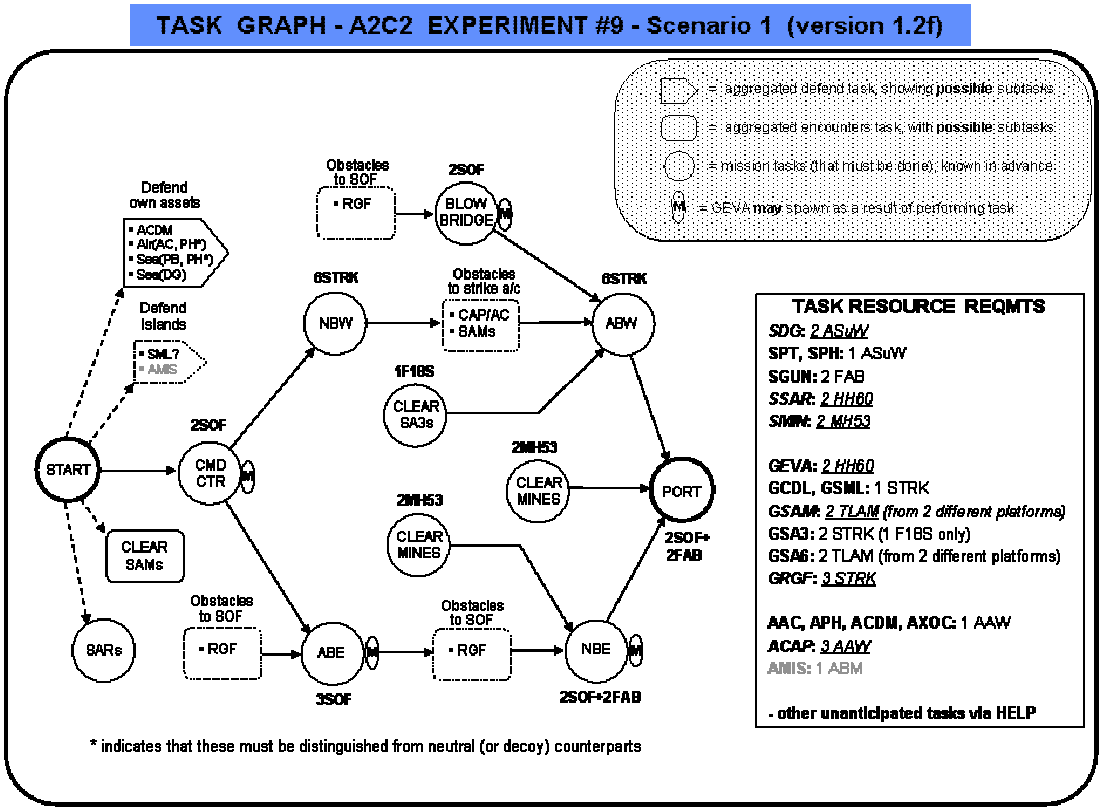


Figure 6. Task Graph – Functional (From A2C2 Experiment 9)

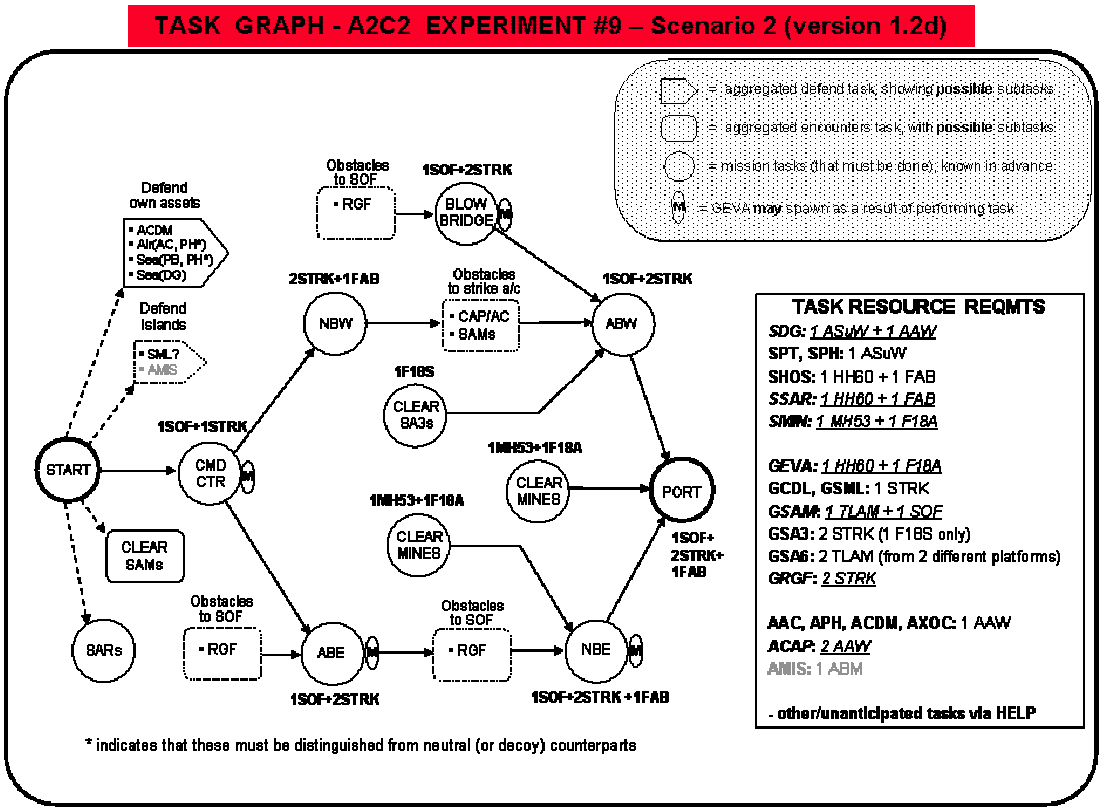


Figure 7. Task Graph – Divisional (From A2C2 Experiment 9)

3. Hypotheses

The initial and overarching question that A2C2 Experiment 9 sought to answer was: given a succession of external and experiential cues regarding the need for organizational change, would there be recognition by the participants of the need to adapt? A follow-on question to that was: given recognition of the need to adapt, would there be a willingness to adapt?

The experiment also sought to investigate the degree of salience of different cues to the different organizational structures; would one initial organizational structure predispose the participants to perceive some cues more strongly than the participants in the other organizational structure?

Finally, the experiment sought to investigate the rationales that motivated the adaptations that were actually made; were those aspects of the scenario that were, by design, intended to catalyze structural change, related to the primary rationales that were cited by the participants? Since the scenarios were "reverse-engineered" to emphasize resource requirements, inter-task coordination, and spatial-temporal loading, were "asset utilization," "reduce coordination," and "balance workload" the rationales that were emphasized by the participants? The list of different rationales is presented here and supporting materials will be discussed more thoroughly in the Data Description and Data Analysis portions of this paper. The rationales and descriptions below are from the original rationale form given to the participants attached in Appendix B.

BW: BALANCE WORKLOAD: To more equitably distribute task processing and/or asset management workload among players.

RC: REDUCE COORDINATION DEMANDS: To reduce the amount of coordination required to perform tasks, e.g., organize around tasks.

CM: ADD COORDINATION MECHANISMS: To provide a coordinator or integrator for one or more kinds of tasks.

SA: IMPROVE SITUATIONAL AWARENESS: To improve SA via (re)defining commanders' Area of Responsibility or Area of Regard.

SR: IMPROVE SPEED OF RESPONSE: To improve team responsiveness, especially for time-critical tasks.

UT: POSITION TEAM TO HANDLE UNANTICIPATED TASKS: To better accommodate unanticipated tasks/events, or surprise enemy tactics.

AU: IMPROVE EFFICIENCY IN ASSET UTILIZATION: To make better use of available assets for tasks processing.

PC: ADJUST TO PLAYERS' CAPABILITIES: To take advantage of a player's skills and/or competencies; compensate for a player's deficiency.

O: OTHER: You may have other reasons driving your change. If so, please indicate them on the reverse of the Roles & Responsibilities worksheet.

It was anticipated that participants would associate increased coordination requirements with the need to adapt their organizational structure to reduce coordination. Increased coordination refers to situations where assets from two or more nodes (ships) in the organization were required to accomplish a task. Decreased coordination generally means that one person owns all the assets to accomplish a task. A basic premise is that reduced coordination demands reduce workload (e.g., the need to communicate and coordinate asset use to synchronize their arrival at a mission task.). Reduced coordination requirements are an indicator of congruence to a particular mission. If participants recognized a lack of congruence it was anticipated that they would redistribute assets to the players who utilize those assets most. Participants will also adapt their organizational structure to balance the cognitive workload distribution among the team members.

4. Assumptions

a. Experimental Assumptions

Assumption 1: Environmental cues designed by the experimental researchers to prompt change in team organizations will be salient enough to the participants to allow them to act on those salient cues in a logical manner. The scenarios developed in Experiment 8 and used in Experiment 9 place equal strain on either the divisionally or functionally organized teams in both the congruent and incongruent scenario play sessions; they prompt the equivalent degree of recognition of either congruence or incongruence and the need to adapt.

Assumption 2: After the initial "hash" scenarios (i.e., training scenarios designed to provide training in aspects of both functional and divisional organizations) and training period, the learning effect would be minimal during the data collection runs. There is a relative equivalence in the level of proficiency with the DDD interface among the different teams.

b. Statistical Assumptions

Data collection during the experimental runs has a normal distribution. The two-tailed Student's t-test with unequal variances was used to examine some of the questions being investigated. An analysis of variance was used to examine some of the other questions being investigated. A qualitative approach was taken with several experimental questions.

5. Statistical Design of Experiment

Five teams each played three scenarios in two sessions. They also conducted two planning sessions between these scenario play sessions and one final planning session after the conclusion of the final scenario play session. Several methods were used to

collect data during the experiment. Performance data was collected by the DDD-III simulator during scenario plays. Experimental researchers coded and tallied communications in real time as scenarios were being played. Observers rated all the planning sessions. The participants provided subjective ratings of the workload levels several times during the scenarios, filled out roles and responsibilities forms during the planning sessions and filled out planning session questionnaires at the conclusion of each planning session.

6. Measures

The DDD-III simulator recorded extensive data during the data collection runs: number of task arrivals, number of attacks on each task class, number of initiated attacks by various decision makers, number of assisted attacks by various decision makers, average accuracy of attacks, and number of times friendly assets were successfully attacked by enemy forces were all recorded onto dependent variable files.

Offensive and defensive scores, and number of tasks attacked relative to the number of tasks in the scenario were calculated and recorded by observers at the conclusion of each scenario play session. Communications during data collection runs were coded and tallied in real time by experimental researchers monitoring voice communications on the voice network. The communications, both during scenario runs and planning sessions, were recorded on audio tape. Data from audio tapes was also later manually transcribed to spreadsheets.

Other measures, such as qualitative organizational changes to roles, responsibilities, coordination, communication, and resource allocation were recorded through observer survey forms and participant forms and questionnaires.

7. Instrumentation

The data collection instrumentation consisted of the DDD-III software. Extensive data was recorded in the dependent variable files. The audio tape recorder, paper observer forms, manual recording of scenario offensive scores, defensive scores, overall number of tasks attacked relative to the number of tasks, and participant questionnaires constituted the other methods used to collect data.

8. Testing and Pilot Trials

Experiment 8 helped to establish some baselines on functional and divisional organizations' performance on different scenarios. Experiment 9's schedule of briefings, training, planning sessions, and scenario plays were tested by the Lead Team prior to the beginning of the actual experiment. The Lead Team played all the scenarios that the experiment groups would be exposed to, including hash runs, no SCUD and SCUD variations, and the functional and divisional scenarios. Lead Team inputs were used to modify experiment handouts, organization graphs, and survey forms. Software modifications to the DDD-III configuration were also made in response to several bugs discovered during the pilot trials.

B. DATA DESCRIPTION

1. Raw Data

The DDD-III software automatically generated a dependent variable file for each scenario run. Data utilized in examining the rationales used by participants to justify asset changes was recorded on roles and responsibilities sheets that participants filled out during their planning sessions. Asset changes were manually recorded by an observer onto an organizational chart during each planning session. Planning session observers conducted a hot wash after each session 3 and 4 to compare notes on the qualitative

details of how teams reacted to the various cues. Communications recorded onto audio tape were later transcribed onto spreadsheets.

2. Data Coding Scheme

Data taken from the DDD-III dependent variable files was imported into Excel files. Data taken from the participant roles and responsibilities forms and the organizational graphs was manually input into Excel files. Data from audio tapes were transcribed onto Excel spreadsheets. Here, each instance in which a rationale was cited on the roles and responsibilities forms, it was entered once in the spreadsheets, whether or not it related to an asset change already described on another form. In some instances two participants may have traded an asset but cited different rationales for the change; each rationale was recorded once in this case. If both participants involved in an asset swap cited the same rationale, that rationale would be entered twice.

3. Data Challenges

Much of the data is qualitative in nature, and different teams may react to the same triggers in radically different ways. More importantly, because of its qualitative nature, differing perspectives of the participants have a profound impact on how they might characterize their rationales for organizational change. It is difficult to characterize or quantify willingness to change or adaptability of organizations. It was exceptionally difficult to characterize the nature of communications due to non-standard communications that the participants utilized. Finally, a few forms are missing and some are incomplete.

4. Data Tables

A condensed summary of the data tables manually input into Excel spreadsheets and a sample dependent variable file from the DDD-III software are included in Appendix C. The statistical analysis of the pertinent data is described in the next chapter.

III. DATA ANALYSIS

A. OVERVIEW

This section describes the analysis plan, the analysis methodology, and the results of the analysis. The probability of rejecting the null hypothesis when it is true (Type I error), $\alpha=0.1$ was selected as the criterion for rejecting null hypotheses. Lastly, some questions were analyzed qualitatively rather than quantitatively.

B. ANALYSIS PLAN

The analysis plan calls for Student's t-test to examine some questions and analysis of variance to look at other questions, and a graphical analysis of these questions. The data for the statistical portion of the analysis came from the participants' roles and responsibilities sheets and the organizational charts.

Other questions were more qualitative in nature and were addressed in a qualitative manner. Data for these questions came from a comparison of the communications logs from the planning sessions and scenario play sessions and data from the dependent variable files from the DDD-III.

C. METHODOLOGY

The following seven questions were examined with graphical and statistical analysis:

1. Are there differences in the number of asset changes and rationales given, depending on the team structure?
2. Are there differences in the number of asset changes and rationales given, depending on the session?

3. Are there differences in the number of asset changes and rationales given, depending on the position that the participant assumed?

4. Are there differences in the types rationales given, depending on the team structure?

5. Are there differences in the types rationales given, depending on the session?

6. Are there differences in the types rationales given, depending on the position the participant assumed?

7. Was there notable variation between the number of times the different rationales were cited?

The Student's t-test was applied to question one data to examine the differences in rationales cited by the teams in the two different organizational structures. An analysis of variance was used for question two data to investigate differences in the aggregated total number of asset changes and rationales cited in the different sessions. An analysis of variance was also performed on the total number of rationales cited, aggregated by team, separated by color to help answer question three. The t-test was again applied to the rationales cited to gain insight into issues investigated in question four. An analysis of variance was conducted again on the rationales cited, separated by session, but not aggregated by team to address question five. An analysis of variance was conducted for question six to investigate the differences in rationales cited by color, but not aggregated by team. The last statistical test was an analysis of variance conducted to investigate the differences between the rationales cited to gain insight into question seven.

For the qualitative questions, transcripts of participants' communications, both during the planning sessions and the scenario play sessions, were examined and compared to some of the performance data available in the dependent variable files of the DDD-III simulator to investigate whether or not teams performed in their scenario play sessions as they had planned, and where they went awry if they did not perform as they had anticipated.

D. RESULTS OF ANALYSIS

It is still early, but it seems that organizations that were originally functionally organized were more reluctant to recognize any need to change their organizational structure than those which were originally divisionally organized (Hollenbeck, et al, 2000). Basic research questions for Experiment 9 centered on whether teams would recognize the need, or the value in, adapting their organizational structures to the upcoming mission. The surrogate measures used to measure this recognition of the need to adapt and willingness to adapt were the number of rationales cited and the number of asset changes actually made. The basic research questions were refined into eight more specific questions. A description of the results of each of these questions follows.

1. Are there differences in the number of asset changes and rationales given, depending on the team structure?

Overall, the divisional teams, A, C, and E, made more asset changes than the functional teams, B and D, as shown in Figure 8. Additionally, these divisional teams also cited significantly more rationales for those changes also shown in Figure 8.

A Student's two-tailed t-test was conducted on each category of rationale, the total number of rationales, and the total number of asset changes, with the divisional teams and functional teams counted as the two samples as shown in Table 1. For this question, the rationales cited, the total number of rationales cited, and the total number of asset changes were aggregated by team within sessions, but separated by session in the graph for clarity; the data was not separated for the t-test. This aggregation was done so that the asset changes would not be double counted, since any one change would have been annotated in more than one roles and responsibility sheet.

As shown in Table 1, t-test p-values showed that, despite the apparently greater inclination of divisionally structured organizations to exchange assets shown graphically in Figure 8, the difference in the total number of asset changes was not statistically significant. While the divisional teams cited more than twice as many rationales as the

functional teams did, but the t-test did not show any statistical significance; this was possibly due to the large variances and small sample sizes. The t-test gave much greater support to the idea that divisionally structured teams seemed more able to recognize the need for change, using the number of rationales cited as a surrogate for the recognition of the need for change (assuming that this is a valid surrogate). The p-value in this case gave a much higher level of confidence that there may be statistical significance to the apparent differences between divisional and functional teams.

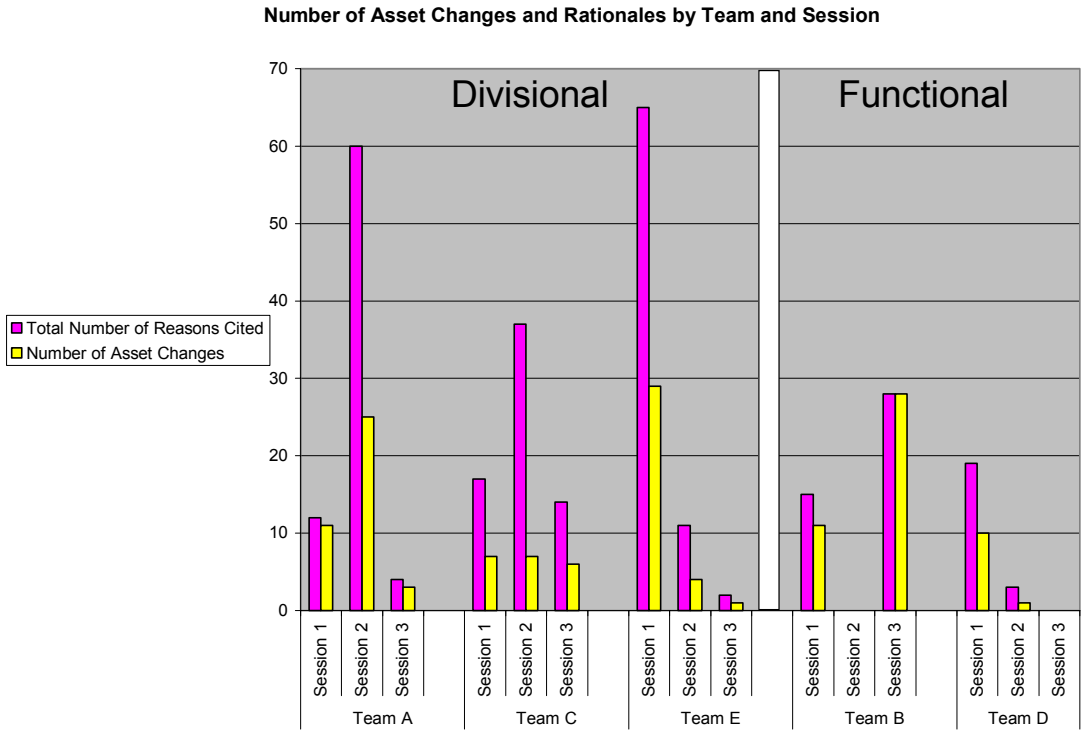


Figure 8. Number of Asset Changes and Rationales by Team and Session

Table 1. Number of Asset Changes and Rationales Cited by Team and Session (t-test)

Session	Team	Total Number of Rationales Cited	Number of Asset Changes
1	**A**	12	11
2	**A**	60	25
3	**A**	4	3
1	**C**	17	7
2	**C**	37	7
3	**C**	14	6
1	**E**	65	29
2	**E**	11	4
3	**E**	2	1
1	**B**	15	11
2	**B**	0	0
3	**B**	28	28
1	**D**	19	10
2	**D**	3	1
3	**D**	0	0
Average	**Div**	24.6667	10.3333
	Func	10.8333	8.3333
Variance	**Div**	561.0000	98.2500
	Func	134.9667	117.8667
Two tail Student's t-test w/unequal variance - probability		0.1584	0.7249

2. Are there differences in the number of asset changes and rationales given, depending on the session?

In general, teams made more changes and cited more rationales for change in the earlier sessions than in the last session as shown in Figure 9 and 10, in spite of the fact that they understood that they would not be required to play in the last organizational structure that they were in (so that player proficiency would not be a factor). Foremost in the minds of the participants seemed to be proficiency; with the exception of Team B, teams made fewer changes in the last session and generally felt that proficiency in the organization that they would "fight" in would be a greater factor in mission success than tailoring their structure to their future mission. The nature of the laboratory training was

such that participants commented often on the need for more training to become familiar with their duties; they generally seemed to believe that they were on the steep part of the learning curve and so could not disentangle that from any perceived benefit from structural changes.

When the number of rationales and asset changes are separated along divisional and functional lines, as seen in Figures 9 and 10, based on the data in Table 2, there is still a general trend in the divisional structure to cite fewer rationales in the last session than in the first two sessions, but when the analyses of variance are conducted, as shown in Tables 3 through 6, there was no strong statistical support for these apparent differences at a significance level of α=0.1. Looking at the asset changes for the functional teams, shown in Figure 10, the most changes were actually made in the last session but, again, there was no strong statistical evidence that these differences were meaningful, at a significance level of α=0.1. Data was aggregated by team so as to avoid double counting asset transfers.



Figure 9. Number of Rationales and Asset Changes by Session – All Divisional Teams Combined

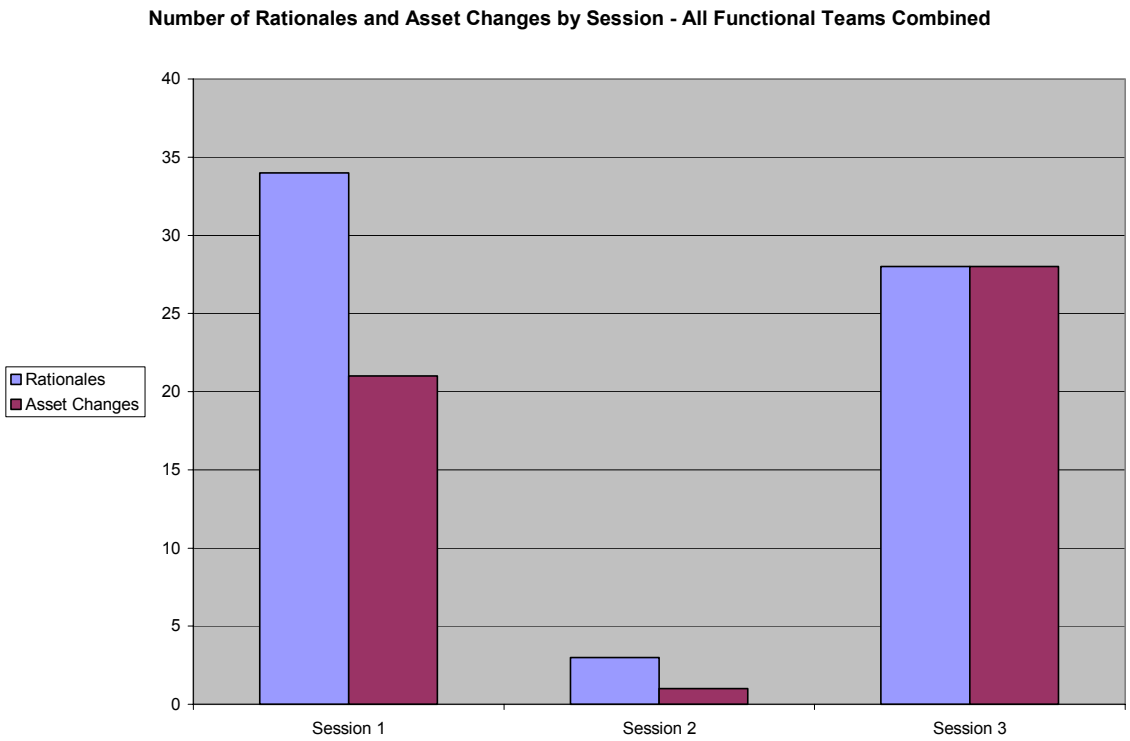


Figure 10. Number of Rationales and Asset Changes by Session – All Functional Teams Combined

Table 2. Asset Changes and Rationales by Team and Session

	Total Number of Rationales Cited			Number of Asset Changes		
Team	**Session 1**	**Session 2**	**Session 3**	**Session 1**	**Session 2**	**Session 3**
A	12	60	4	11	25	3
C	17	37	14	7	7	6
E	65	11	2	29	4	1
B	15	0	28	11	0	28
D	19	3	0	10	1	0

Table 3. Rationales by Session – Divisional Teams (ANOVA)

ANOVA: Single Factor - Rationales Cited by Session - Divisional Teams

Alpha = 0.1

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Session 1	3	94	31.3333	856.3333
Session 2	3	108	36.0000	601.0000
Session 3	3	20	6.6667	41.3333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1490.6667	2	745.3333	1.4920	0.2979	3.4633
Within Groups	2997.3333	6	499.5556			
Total	4488	8				

Table 4. Rationales by Session – Functional Teams (ANOVA)

ANOVA: Single Factor - Rationales Cited by Session - Functional Teams

Alpha = 0.1

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Session 1	2	34	17.0000	8.0000
Session 2	2	3	1.5000	4.5000
Session 3	2	28	14.0000	392.0000

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	270.3333	2	135.1667	1.0025	0.4641	5.4624
Within Groups	404.5000	3	134.8333			
Total	674.8333	5				

Table 5. Asset Changes by Session –Divisional Teams (ANOVA)

ANOVA: Single Factor - Asset Changes by Session - Divisional Teams

Alpha = 0.1

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Session 1	3	47	15.6667	137.3333
Session 2	3	36	12.0000	129.0000
Session 3	3	10	3.3333	6.3333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	240.6667	2	120.3333	1.3240	0.3340	3.4633
Within Groups	545.3333	6	90.8889			
Total	786	8				

Table 6. Asset Changes by Session –Functional Teams (ANOVA)

ANOVA: Single Factor - Asset Changes Cited by Session - Functional Teams

Alpha = 0.1

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Session 1	2	21	10.5000	0.5000
Session 2	2	1	0.5000	0.5000
Session 3	2	28	14.0000	392.0000

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	196.3333	2	98.1667	0.7494	0.5446	5.4624
Within Groups	393.0000	3	131.0000			
Total	589.3333	5				

3. Are there differences in the number of asset changes and rationales given, depending on the position that the participant assumed?

In the divisional teams, Purple proffered the most rationales by far, while Blue and Red cited the fewest rationales; there was a roughly threefold difference in the

number of rationales cited between these groups as shown in Figure 11, and based on Table 7. Green, Brown, and Orange were intermediate between these extremes. In the divisional structure, where there was the greatest difference in the number of rationales cited with respect to the other players, purple's geographic isolation may have put it under greater pressure, especially when it came to mounting a coordinated defense in Purple's area of responsibility.

As can be seen in Figure 12, Purple and Orange cite the most rationales in the functional teams. Purple may have cited the most rationales under the functional structure because his primary purpose, vis-à-vis all the other players, was that of battlespace awareness, involving him in all the other positions' rationales. Purple may have been keeping a bigger picture of the unfolding battle.

There were a great number of asset transfers by Purple and Red. This occurred because, in the functional scenario, Red owned a lot of the aircraft, which seemed to be traded often. Also, in the functional scenario, when the SCUD threat is introduced, teams tended to assign the new assets to one player position, Purple. Even in the divisionally organized structures, there was a tendency to assign the new assets to Purple. Consequently, Purple also cited the most rationales in the divisional structure.

When analyses of variance were conducted, however, there was no strong statistical support for the difference in asset changes at a significance level of $\alpha=0.1$ as shown in Tables 9 and 11. However, while it was still not statistically significant at a significance level of $\alpha=0.1$, there was somewhat stronger support for the differences in the total number of rationales cited by the different player positions, as shown in Tables 8 and 10.

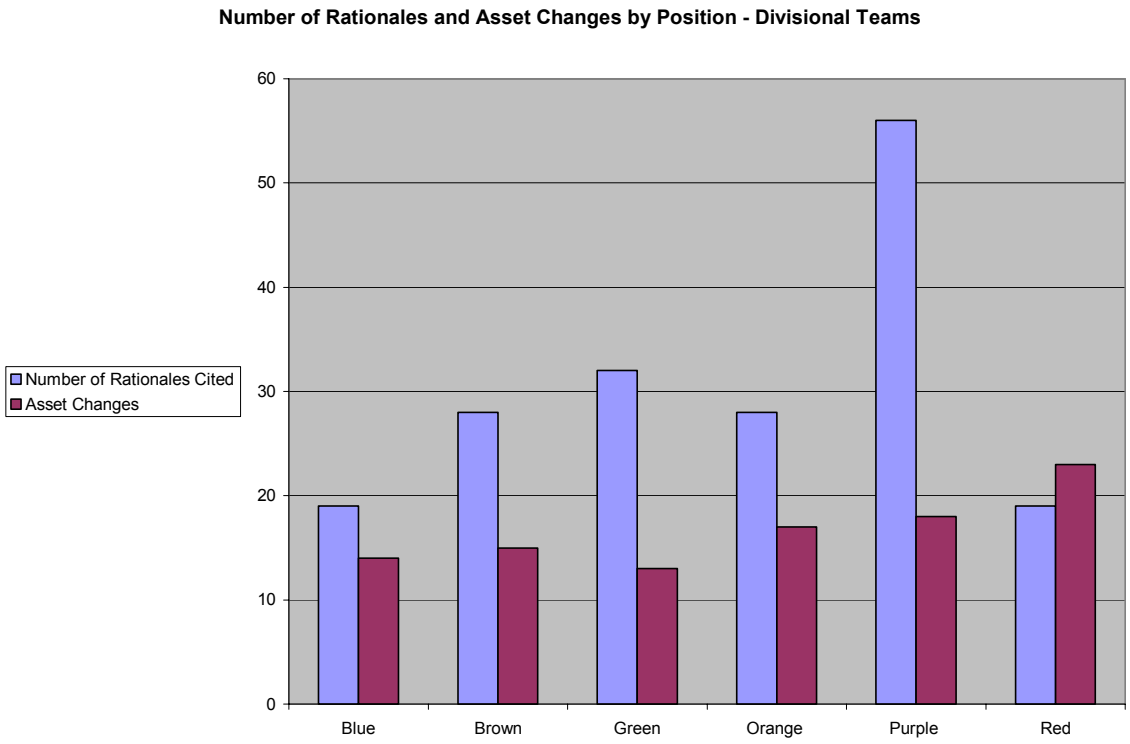


Figure 11. Number of Rationales and Asset Changes by Position** – Divisional Teams

** Color: (Divisional Role/Functional Role), Blue was DDGA/SAR, Brown was DDGC/SOF, Orange was DDGB/SuWC, Green was CVN/STRIKE, Purple was FFG/ISR, and Red was CG/AWC.

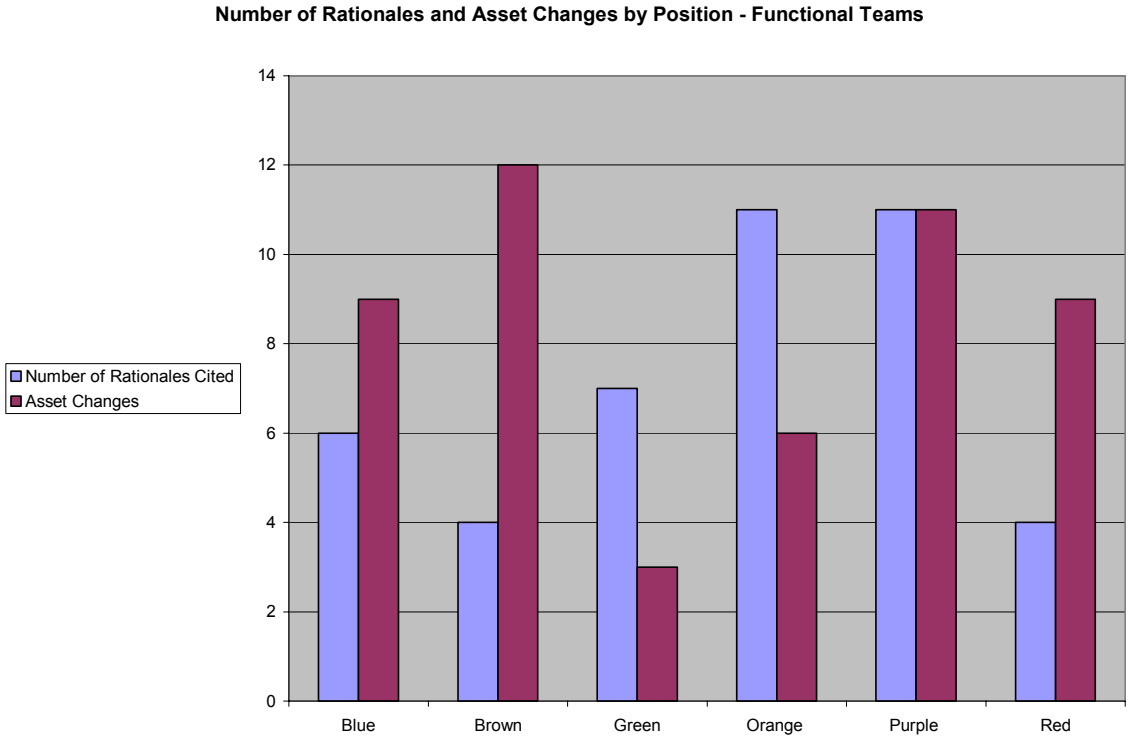


Figure 12. Number of Rationales and Asset Changes by Position** – Functional Teams

Table 7. Number of Rationales and Asset Changes by Position**

		Total Number of Rationales Cited						Total Asset Changes					
Session	**Team**	**Blue**	**Brown**	**Green**	**Orange**	**Purple**	**Red**	**Blue**	**Brown**	**Green**	**Orange**	**Purple**	**Red**
1	**A**	4	4	1	4	2	5	4	3	0	2	0	2
2	**A**	3	11	3	11	22	1	2	3	6	4	5	5
3	**A**	1	0	0	1	2	0	0	4	0	1	2	0
1	**B**	1	1	1	1	3	1	0	7	0	0	4	0
2	**B**	1	1	2	1	3	1	0	0	0	0	0	0
3	**B**	1	1	1	1	3	1	6	4	3	6	4	5
1	**C**	2	3	2	2	0	2	1	1	0	1	0	4
2	**C**	2	5	7	3	9	3	1	1	2	1	1	1
3	**C**	1	0	7	0	9	2	0	0	0	0	0	6
1	**D**	2	0	0	3	1	1	3	0	0	0	3	4
2	**D**	1	1	3	5	1	0	0	1	0	0	0	0
3	**D**	0	0	0	0	0	0	0	0	0	0	0	0
1	**E**	1	5	10	3	6	2	4	3	4	6	8	4
2	**E**	2	0	2	4	2	3	1	0	1	2	1	1
3	**E**	3	0	0	0	4	1	1	0	0	0	1	0

** Color: (Divisional Role/Functional Role), Blue was DDGA/SAR, Brown was DDGC/SOF, Orange was DDGB/SuWC, Green was CVN/STRIKE, Purple was FFG/ISR, and Red was CG/AWC.

Table 8. Rationales by Position** - Divisional Teams (ANOVA)

ANOVA: Single Factor

Alpha = 0.1

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Blue	9	19	2.1111	1.1111
Brown	9	28	3.1111	13.6111
Green	9	32	3.5556	12.7778
Orange	9	28	3.1111	11.1111
Purple	9	56	6.2222	45.1944
Red	9	19	2.1111	2.1111

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	103.2593	5	20.6519	1.4422	0.2264	1.9711
Within Groups	687.3333	48	14.3194			
Total	790.5926	53				

Table 9. Asset Changes by Position** - Divisional Teams (ANOVA)

ANOVA: Single Factor

Alpha = 0.1

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Blue	9	14	1.5556	2.2778
Brown	9	15	1.6667	2.5000
Green	9	13	1.4444	4.7778
Orange	9	17	1.8889	3.8611
Purple	9	18	2.0000	7.5000
Red	9	23	2.5556	5.0278

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	7.2593	5	1.4519	0.3358	0.8888	1.9711
Within Groups	207.5556	48	4.3241			
Total	214.8148	53				

** Color: (Divisional Role/Functional Role), Blue was DDGA/SAR, Brown was DDGC/SOF, Orange was DDGB/SuWC, Green was CVN/STRIKE, Purple was FFG/ISR, and Red was CG/AWC.

Table 10. Rationales by Position** - Functional Teams (ANOVA)

ANOVA: Single Factor

Alpha = 0.1

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Blue	6	6	1.0000	0.4000
Brown	6	4	0.6667	0.2667
Green	6	7	1.1667	1.3667
Orange	6	11	1.8333	3.3667
Purple	6	11	1.8333	1.7667
Red	6	4	0.6667	0.2667

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	8.4722	5	1.6944	1.3677	0.2642	2.0492
Within Groups	37.1667	30	1.2389			
Total	45.6389	35				

Table 11. Asset Changes by Position** - Functional Teams (ANOVA)

ANOVA: Single Factor

Alpha = 0.1

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Blue	6	9	1.5000	6.3000
Brown	6	12	2.0000	8.4000
Green	6	3	0.5000	1.5000
Orange	6	6	1.0000	6.0000
Purple	6	11	1.8333	4.1667
Red	6	9	1.5000	5.5000

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	9.2222	5	1.8444	0.3473	0.8799	2.0492
Within Groups	159.3333	30	5.3111			
Total	168.5556	35				

** Color: (Divisional Role/Functional Role), Blue was DDGA/SAR, Brown was DDGC/SOF, Orange was DDGB/SuWC, Green was CVN/STRIKE, Purple was FFG/ISR, and Red was CG/AWC.

4. Are there differences in the types of rationales given, depending on the team structure?

Divisional teams appeared to cite a greater variety of rationales for their changes than did the functional teams, as shown in Figure 13. This may occur because more players were exposed to a greater variety of tasks and assets in the divisionally structured teams. The preponderance of rationales across all teams was still balanced workload, reduced coordination, and asset utilization.

Table 12 provides results of the Student's t-test that showed there is strong support for the idea that there are genuine differences in the propensity of differently organized teams to cite certain rationales. Differences were most pronounced, and most statistically significant, in the total number of rationales cited for the following rationales: Balance Workload, Reduced Coordination, Situational Awareness, and Asset Utilization. In all cases, the divisionally organized teams were far more likely to cite these rationales. The complete data table on which this t-test was performed can be found in Appendix D.

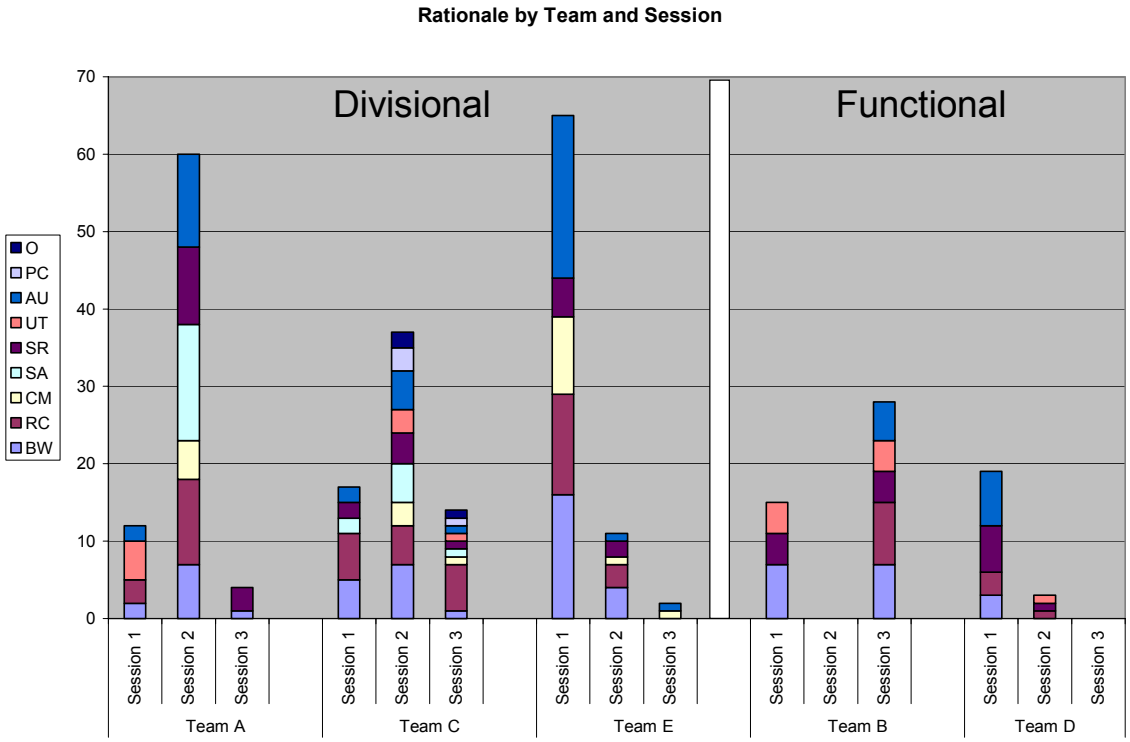


Figure 13. Rationales* by Team and Session

Table 12. Rationales* by Team Structure (t-test)

		Rationale Cited									
Color	**Team**	**BW**	**RC**	**CM**	**SA**	**SR**	**UT**	**AU**	**PC**	**O**	**Total Number of Reasons Cited**
Average	**Div**	0.741	0.648	0.296	0.370	0.426	0.148	0.574	0.056	0.111	3.370
	Func	0.361	0.111	0.167	0.028	0.194	0.056	0.167	0.028	0.083	1.194
Variance	**Div**	1.177	1.176	0.477	1.294	1.079	0.204	1.306	0.053	0.176	14.917
	Func	0.237	0.102	0.314	0.028	0.161	0.054	0.200	0.028	0.079	1.304
Two tail Student's t-test w/unequal variance - probability		0.0270	0.0011	0.3307	0.0336	0.1431	0.2060	0.0208	0.5098	0.7075	0.0002

* Rationale: BW – Balance Workload, RC – Reduce Coordination, CM – Coordination Mechanism, SA – Situational Awareness, SR – Speed of Response, UT – Unanticipated Tasks, AU – Asset Utilization, PC – Players' Capabilities, O – Other.

5. Are there differences in the types rationales given, depending on the session?

When the types of rationales were broken down by session, there appeared to be a definite inclination across all teams to cite balance workload, reduce coordination, and asset utilization in session one, while there were no particularly dominant rationales in the second session as shown in Figure 14. In the last session, the three major rationales again came to predominate. The inclination to cite balance workload, reduce coordination, and asset utilization in session one is likely due to participants' exposure to these emphasis areas in briefings by, and discussions with, the experimenters and planning session moderators. Situational awareness was next most cited rationale after these; this is likely because situational awareness is strongly emphasized in the military environment and the familiarity with the concept makes it foremost in the minds of military personnel.

As participants became more familiar with the rationales on the handout, and their manifestations in the scenario, participants were able to refer to more of them in the second planning session. During the third planning session, when the participants were just exposed to an incongruent scenario, their rationales became less varied and fewer overall. The incongruent scenario may have focused their attention on those aspects of teamwork that the scenarios were *designed* to stress. These factors also happened to be the emphasis areas highlighted by the moderators.

When a two-factor (session, rationale) analysis of variance was conducted at a significance level of $\alpha=0.1$, there was strong support for the differences in frequency with which rationales were cited by session, as shown in Table 13. There was strong support for the differences seen in the frequency with which each rationale was cited. There was no strong interaction between rationales cited and session; there was no significant pattern of rationales by session. The complete table on which the analysis was conducted can be found in Appendix D.

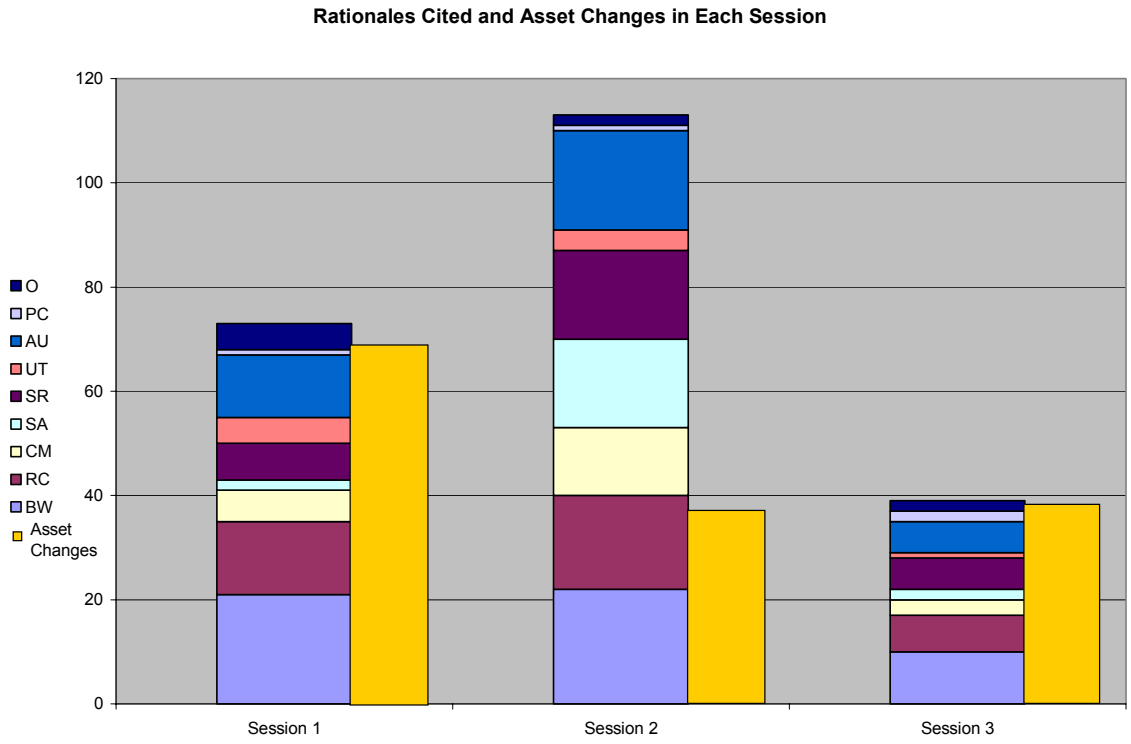


Figure 14. Rationales* Cited and Asset Changes in Each Session

* Rationale: BW – Balance Workload, RC – Reduce Coordination, CM – Coordination Mechanism, SA – Situational Awareness, SR – Speed of Response, UT – Unanticipated Tasks, AU – Asset Utilization, PC – Players' Capabilities, O – Other.

Table 13. Rationales* Cited by Session (ANOVA)

ANOVA: Two-Factor With Replication

Alpha = 0.1

SUMMARY	BW	RC	CM	SA	SR	UT	AU	PC	O	Total
1										
Count	30	30	30	30	30	30	30	30	30	270
Sum	21	14	6	2	7	5	12	1	5	73
Average	0.7000	0.4667	0.2000	0.0667	0.2333	0.1667	0.4000	0.0333	0.1667	0.2704
Variance	0.9759	1.1540	0.4414	0.0644	0.1851	0.2816	0.6621	0.0333	0.2816	0.4805
2										
Count	30	30	30	30	30	30	30	30	30	270
Sum	22	18	13	17	17	4	19	1	2	113
Average	0.7333	0.6000	0.4333	0.5667	0.5667	0.1333	0.6333	0.0333	0.0667	0.4185
Variance	0.9609	0.8000	0.5989	2.1851	1.7023	0.1195	1.7575	0.0333	0.0644	0.9506
3										
Count	30	30	30	30	30	30	30	30	30	270
Sum	10	7	3	2	6	1	6	2	2	39
Average	0.3333	0.2333	0.1000	0.0667	0.2000	0.0333	0.2000	0.0667	0.0667	0.1444
Variance	0.5057	0.4609	0.1621	0.0644	0.2345	0.0333	0.2345	0.0644	0.0644	0.2058
Total										
Count	90	90	90	90	90	90	90	90	90	
Sum	53	39	22	21	30	10	37	4	9	
Average	0.5889	0.4333	0.2444	0.2333	0.3333	0.1111	0.4111	0.0444	0.1000	
Variance	0.8291	0.8101	0.4115	0.8101	0.7191	0.1448	0.8965	0.0429	0.1360	

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	10.1630	2	5.0815	9.7131	0.0001	2.3094
Columns	23.2889	8	2.9111	5.5645	0.0000	1.6781
Interaction	7.4148	16	0.4634	0.8858	0.5859	1.4803
Within	409.6333	783	0.5232			
Total	450.5000	809				

* Rationale: BW – Balance Workload, RC – Reduce Coordination, CM – Coordination Mechanism, SA – Situational Awareness, SR – Speed of Response, UT – Unanticipated Tasks, AU – Asset Utilization, PC – Players' Capabilities, O – Other.

6. Are there differences in the types rationales given, depending on the position the participant assumed?

Figure 15 provides a general indication of the relative variety and proportions of the different players' rationales in the divisional structure while Figure 16 does the same for the functional structure.

In the divisional structure, Purple and Blue cited the greatest variety of rationales, using 9 and 8 of the 9 available choices of rationale, as shown in Figure 15. Brown, Green, and Orange cited an intermediate variety of rationales, while Red cited the lowest variety of rationales. For the positions that cited the greatest variety of rationales, no one rationale appeared to predominate. For Red, which only cited three rationales, reduce coordination and balance workload were the predominant concerns.

In the functional structure, as shown in Figure 16, Purple and Green cited the greatest variety of rationales while Red cited the least. Speed of response seemed to be the primary concern for Purple, while Red cited "other" most often. Balance workload was cited often by the other positions, but did not dominate their reasoning. Green cited reduce coordination more than balance workload while Orange cited player competency as often as balance workload.

When two-factor (color, rationale) analyses of variance were conducted at significance level $\alpha=0.1$, there was strong support for the differences in frequency with which rationales were cited by the different player positions for both divisional and functional structures, as shown in Tables 14 and 15.

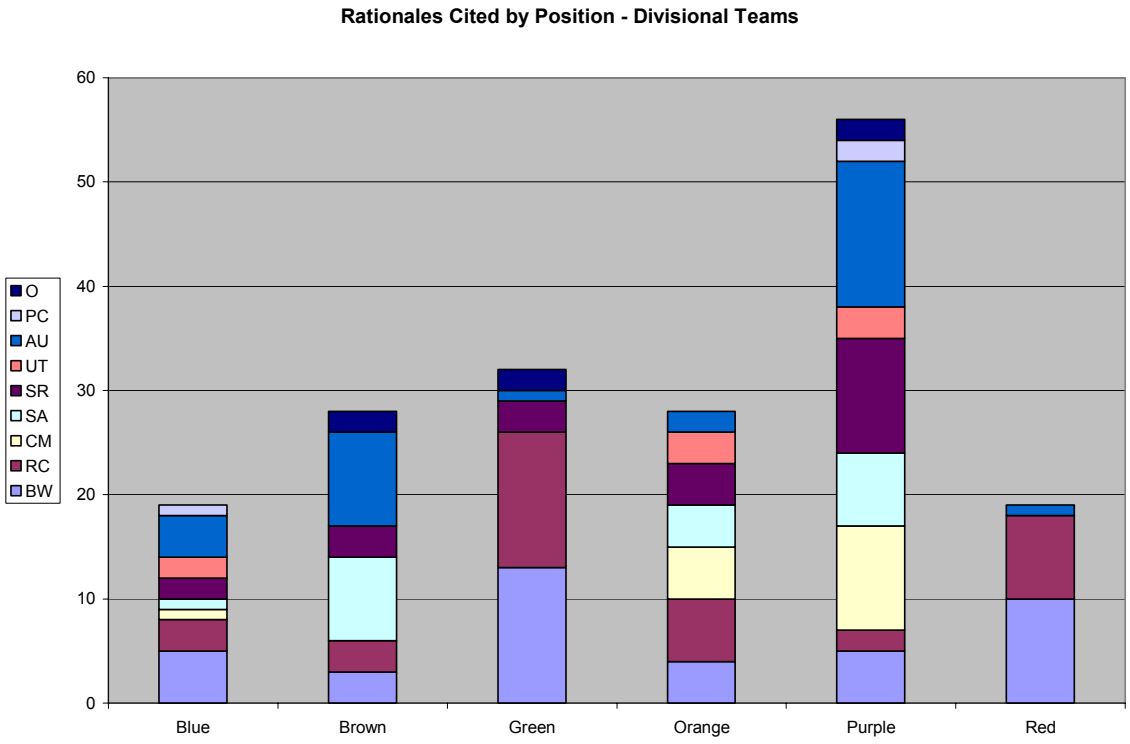


Figure 15. Rationales* Cited by Position** - Divisional Teams

* Rationale: BW – Balance Workload, RC – Reduce Coordination, CM – Coordination Mechanism, SA – Situational Awareness, SR – Speed of Response, UT – Unanticipated Tasks, AU – Asset Utilization, PC – Players' Capabilities, O – Other.

** Color: (Divisional Role/Functional Role), Blue was DDGA/SAR, Brown was DDGC/SOF, Orange was DDGB/SuWC, Green was CVN/STRIKE, Purple was FFG/ISR, and Red was CG/AWC.

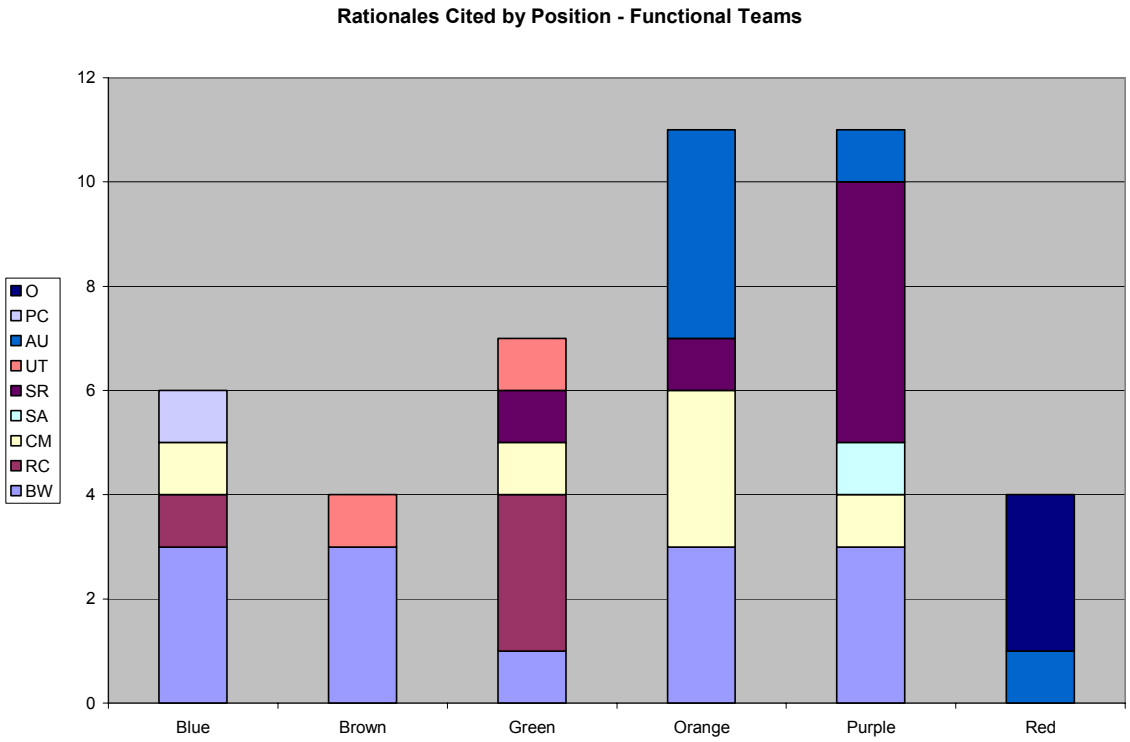


Figure 16. Rationales* Cited by Position** - Functional Teams

Table 14. Rationales by Position – Divisional Teams (ANOVA)

ANOVA: Two-Factor With Replication

Alpha = 0.1

SUMMARY	BW	RC	CM	SA	SR	UT	AU	PC	O	Total
Blue										
Count	9	9	9	9	9	9	9	9	9	81
Sum	5	3	1	1	2	2	4	1	0	19
Average	0.5556	0.3333	0.1111	0.1111	0.2222	0.2222	0.4444	0.1111	0.0000	0.2346
Variance	0.5278	0.5000	0.1111	0.1111	0.1944	0.4444	0.2778	0.1111	0.0000	0.2568
Brown										
Count	9	9	9	9	9	9	9	9	9	81
Sum	3	3	0	8	3	0	9	0	2	28
Average	0.3333	0.3333	0.0000	0.8889	0.3333	0.0000	1.0000	0.0000	0.2222	0.3457
Variance	0.5000	0.2500	0.0000	3.8611	0.2500	0.0000	2.2500	0.0000	0.4444	0.8790

* Rationale: BW – Balance Workload, RC – Reduce Coordination, CM – Coordination Mechanism, SA – Situational Awareness, SR – Speed of Response, UT – Unanticipated Tasks, AU – Asset Utilization, PC – Players' Capabilities, O – Other.

** Color: (Divisional Role/Functional Role), Blue was DDGA/SAR, Brown was DDGC/SOF, Orange was DDGB/SuWC, Green was CVN/STRIKE, Purple was FFG/ISR, and Red was CG/AWC.

Green										
Count	9	9	9	9	9	9	9	9	9	81
Sum	13	13	0	0	3	0	1	0	2	32
Average	1.4444	1.4444	0.0000	0.0000	0.3333	0.0000	0.1111	0.0000	0.2222	0.3951
Variance	3.2778	3.2778	0.0000	0.0000	0.2500	0.0000	0.1111	0.0000	0.4444	1.0670

Orange										
Count	9	9	9	9	9	9	9	9	9	81
Sum	4	6	5	4	4	3	2	0	0	28
Average	0.4444	0.6667	0.5556	0.4444	0.4444	0.3333	0.2222	0.0000	0.0000	0.3457
Variance	1.0278	1.0000	0.7778	1.0278	0.2778	0.5000	0.1944	0.0000	0.0000	0.5290

Purple										
Count	9	9	9	9	9	9	9	9	9	81
Sum	5	2	10	7	11	3	14	2	2	56
Average	0.5556	0.2222	1.1111	0.7778	1.2222	0.3333	1.5556	0.2222	0.2222	0.6914
Variance	0.5278	0.1944	1.1111	2.6944	5.1944	0.2500	3.7778	0.1944	0.1944	1.6410

Red										
Count	9	9	9	9	9	9	9	9	9	81
Sum	10	8	0	0	0	0	1	0	0	19
Average	1.1111	0.8889	0.0000	0.0000	0.0000	0.0000	0.1111	0.0000	0.0000	0.2346
Variance	0.8611	1.3611	0.0000	0.0000	0.0000	0.0000	0.1111	0.0000	0.0000	0.4068

Total									
Count	54	54	54	54	54	54	54	54	54
Sum	40	35	16	20	23	8	31	3	6
Average	0.7407	0.6481	0.2963	0.3704	0.4259	0.1481	0.5741	0.0556	0.1111
Variance	1.1768	1.1758	0.4766	1.2942	1.0793	0.2041	1.3057	0.0535	0.1761

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	11.4733	5	2.2947	3.2208	0.0072	1.8607
Columns	25.9177	8	3.2397	4.5473	0.0000	1.6845
Interaction	48.6749	40	1.2169	1.7080	0.0057	1.3156
Within	307.7778	432	0.7124			
Total	393.8436	485				

Table 15. Rationales* by Position – Functional Teams (ANOVA)

ANOVA: Two-Factor With Replication

Alpha = 0.1

SUMMARY	BW	RC	CM	SA	SR	UT	AU	PC	O	Total
Blue										
Count	9	9	9	9	9	9	9	9	9	81
Sum	5	1	1	0	0	0	0	1	0	8
Average	0.5556	0.1111	0.1111	0.0000	0.0000	0.0000	0.0000	0.1111	0.0000	0.0988
Variance	0.2778	0.1111	0.1111	0.0000	0.0000	0.0000	0.0000	0.1111	0.0000	0.0901
Brown										
Count	9	9	9	9	9	9	9	9	9	81
Sum	2	3	1	0	1	2	0	0	0	9
Average	0.2222	0.3333	0.1111	0.0000	0.1111	0.2222	0.0000	0.0000	0.0000	0.1111
Variance	0.1944	0.2500	0.1111	0.0000	0.1111	0.1944	0.0000	0.0000	0.0000	0.1000
Orange										
Count	9	9	9	9	9	9	9	9	9	81
Sum	5	0	4	1	4	0	4	0	0	18
Average	0.5556	0.0000	0.4444	0.1111	0.4444	0.0000	0.4444	0.0000	0.0000	0.2222
Variance	0.2778	0.0000	1.0278	0.1111	0.2778	0.0000	0.5278	0.0000	0.0000	0.2750
Purple										
Count	9	9	9	9	9	9	9	9	9	81
Sum	1	0	0	0	2	0	2	0	3	8
Average	0.1111	0.0000	0.0000	0.0000	0.2222	0.0000	0.2222	0.0000	0.3333	0.0988
Variance	0.1111	0.0000	0.0000	0.0000	0.1944	0.0000	0.1944	0.0000	0.2500	0.0901
Total										
Count	36	36	36	36	36	36	36	36	36	
Sum	13	4	6	1	7	2	6	1	3	
Average	0.3611	0.1111	0.1667	0.0278	0.1944	0.0556	0.1667	0.0278	0.0833	
Variance	0.2373	0.1016	0.3143	0.0278	0.1611	0.0540	0.2000	0.0278	0.0786	

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	0.8735	3	0.2912	2.3583	0.0718	2.1029
Columns	3.2099	8	0.4012	3.2500	0.0015	1.6916
Interaction	5.6543	24	0.2356	1.9083	0.0074	1.4100
Within	35.5556	288	0.1235			
Total	45.2932	323				

* Rationale: BW – Balance Workload, RC – Reduce Coordination, CM – Coordination Mechanism, SA – Situational Awareness, SR – Speed of Response, UT – Unanticipated Tasks, AU – Asset Utilization, PC – Players' Capabilities, O – Other.

7. Was there notable variation between the number of times the different rationales were cited?

The last single factor analysis of variance was performed to determine whether there were significant difference in the number of instances in which different rationales cited, regardless of team structure, session, or player position, as shown in Table 16. This was performed to determine whether: 1) the scenarios stressed the teams in the manner in which they were intended, and 2) the emphasis areas stressed by the moderators and experimental researchers were more salient to the participants than those areas which were not emphasized.

The balance workload, reduce coordination, and asset utilization were, by far, the most often cited rationales. These areas correlated well with the design of the scenarios developed and validated in A2C2 Experiment 8 and utilized in Experiment 9. The scenarios had been "reverse-engineered" for this purpose, with emphasis on resource requirements, inter-task coordination, and spatial-temporal loading. These rationales also correlated with the emphasis areas stressed by the moderators in the briefings and planning sessions, especially the "primer" on organizational structure briefed to all the experiment groups. It is difficult to disentangle the effects of the incongruent scenarios and the moderators' influences. But it seems that some combination of both influenced the participants' perception of salient cues for the need to change. Whether they would change was another matter.

Green, Blue, and Red overwhelmingly cited balanced workload and reduced coordination as the rationales provided for most changes. Brown's focus was both balanced workload and asset utilization. For Purple and Orange, no particular rationale appeared to predominate. In the functional structure, Purple has intelligence, surveillance and reconnaissance (battlespace awareness) and the SCUD threat as the primary role. In the divisional structure; Purple's geographic separation from the main area of offensive operations tends to isolate it from much of the action. The greater number of roles that some of the other players had in mission prosecution may have focused their thoughts more when they considered issues of primary importance to them.

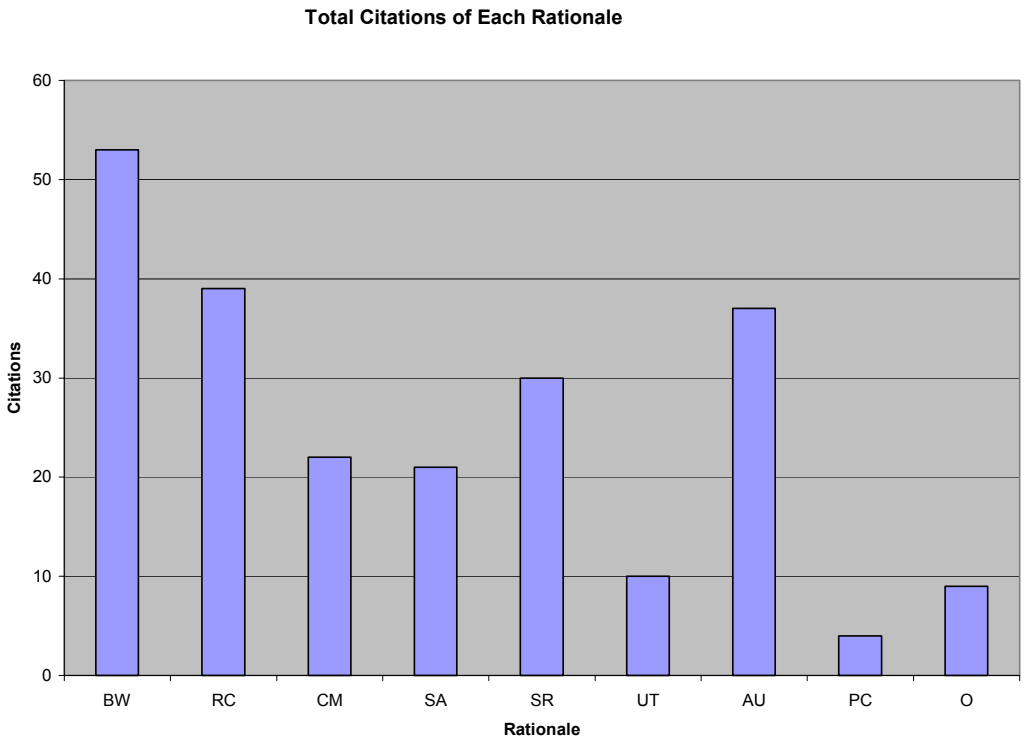


Figure 17. Total Citations of Each Rationale*

* Rationale: BW – Balance Workload, RC – Reduce Coordination, CM – Coordination Mechanism, SA – Situational Awareness, SR – Speed of Response, UT – Unanticipated Tasks, AU – Asset Utilization, PC – Players' Capabilities, O – Other.

Table 16. Differences in Frequency of Rationale* Cited (ANOVA)

ANOVA: Single Factor

Alpha = 0.1

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
BW	90	53	0.5889	0.8291
RC	90	39	0.4333	0.8101
CM	90	22	0.2444	0.4115
SA	90	21	0.2333	0.8101
SR	90	30	0.3333	0.7191
UT	90	10	0.1111	0.1448
AU	90	37	0.4111	0.8965
PC	90	4	0.0444	0.0429
O	90	9	0.1000	0.1360

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	23.2889	8	2.9111	5.4582	0.0000	1.6779
Within Groups	427.2111	801	0.5333			
Total	450.5000	809				

8. Main themes of the planning sessions, and planning versus performance

To investigate the relationship between intentions stated by team members in the planning sessions and the performance in the follow-on scenario, transcripts from the planning sessions, the scenario play sessions, and the dependent variable files from those scenario play sessions (obtained from the DDD-III simulator), were compared qualitatively. These files were grouped together for comparison; a representative set of six groups was chosen for this qualitative analysis.

* Rationale: BW – Balance Workload, RC – Reduce Coordination, CM – Coordination Mechanism, SA – Situational Awareness, SR – Speed of Response, UT – Unanticipated Tasks, AU – Asset Utilization, PC – Players' Capabilities, O – Other.

For Team A, plan, play, and dependent variable files were examined for Plays #1 and #2. In their first planning session, the primary concerns expressed were a lack of timely support for operations that required coordination and uncertainty about where the threats to friendly forces might materialize. Other concerns centered around workload and the emerging SCUD threat. The concern with the lack of timely support and uncertainty, especially, drove this team to emphasize a dispersion of assets and a reliance on coordination mechanisms, rather than consolidating responsibilities. Geographic closeness to targets and air defense zones were issues that were also brought out in relation to situational awareness and drove the dispersion of forces. In the follow-on scenario play session, the team incurred many losses to airborne threats and failed to take two objectives: Air Base West and the final Port objective. In Team A's second planning session, the issues of timely self-defense of friendly platforms, workload, geographic division of responsibilities, time criticality of certain tasks, and timeline coordination for mission tasking, were discussed with relatively equal emphasis. In the second scenario play session, the communications logs suggested the time limits on sub-platforms were expiring before tasks could be executed. Competing priorities appeared to cause the team to redirect assets en route to other tasking; this may have contributed to the problem of sub-platforms expiring before tasks could be completed. The team incurred few air losses in the second session, but still failed to take two objectives: Naval Base East and the final objective.

For Team B, situational awareness, especially as it related to the need to zoom in and out, was, by far, the biggest concern in their first planning session. This need to zoom in and out occurs when a player has different types of tasks to accomplish. Some tasks can be prosecuted without zooming in (e.g., destroying an air base); other tasks require the player to zoom to prosecute the task (e.g., clearing mines, search and rescue, and SOF missions). To address the problem of situational awareness, discussion centered on regionalizing roles and responsibilities. A "hybrid" organizational structure was discussed, that is a structure that combines aspects of both a functional and divisional organization. Other issues brought out were confusion regarding "buttonology" (i.e., asset use for assets they had not used previously), proficiency issues as they might relate to asset transfers, and workload, although Team B considered workload issues a side

effect of their poor situational awareness. In their first scenario play session, communications were dominated by the SCUD threat, defensive tasks, and unanticipated time critical tasks. The associated dependent variable file indicates that they took heavy losses to cruise missiles, patrol boats, and suffered numerous air penetrations.

For Team C, the first planning session centered around search and rescue (SAR) missions; one player dominated the discussion on this aspect of the scenario, and it drove others to concentrate on this issue also. Zones for search and rescue responsibility were discussed, and this concept was extended to the other warfare functions. Situational awareness of these time critical tasks drove the team to consider a three-region, combination divisional/functional structure (i.e., a hybrid organization), although they did not actually adopt it in the end. Other concerns for this team included the different speed of response required on the different time critical tasks: slow for SAR and mine clearance, fast for air threats and patrol boats. Lastly, workload issues and the SCUD threat were brought up. Communications were extremely confused during the scenario play. Phrases like "what," "where," "who," "I'm confused," "you've gone too far," "which one," "wait," and "say again" came up frequently and indicated that teammates were speaking over each other. Misallocated assets were also indicated in the communications transcripts. The associated dependent variable file indicated that the team performed reasonably well in defending themselves against air attacks and threats to friendly platforms, but they failed to take a number of the objectives: Naval Base East, Naval Base West, Air Base West, and the final objective. The team's performance was low compared to most of the other team's performances.

Team D brought up platform self-defense as their primary concern in their first planning session. Other issues that were brought up included balancing workload, situational awareness, and unanticipated time critical tasking. The team decided that whichever player had slack time would serve as an ad hoc coordinator for the unanticipated, time critical tasks. In the accompanying scenario play session, communications were notable for their brevity. The associated dependent variable file showed that the team did very well all around, both offensively and defensively, and completed the entire scenario. This team's performance was the best of all the scenario play runs for the entire experiment.

For Team E, their second planning session centered around workload balancing, the employment of TLAMs, both in terms of timing them properly and on the types of targets they should be used on, and the issue of SAMs. The team decided that TLAMs should be employed to clear the SAM threat in order to allow freer employment of the F-18s. Team E also decided to divide the task graph objectives among the players. The communications transcripts in the follow-on scenario gave the impression of good coordination. Messages seemed to be balanced between mission tasking, defensive tasking, and unanticipated tasking. At the end, more and more communications were focused on defensive tasking. The data file indicated that Team E performed reasonably well in terms of enemy penetrations but were hit hard with an enemy aircraft wave and Exocet missiles. On mission tasking, they failed only to take the last objective, the Port.

For the teams overall, the direction of the discussions appeared to hinge more on the personalities of the participants than on anything else. For such small sample sizes, it might be difficult to identify the most relevant themes that might recur over and over again due to the salient environmental cues built into the experiment. Statistical testing performed for the previous questions suggests that moderators have a strong impact on seeding rationales into the minds of the participants. Whether this means that participants genuinely understood the direction that the moderators gave them or just that they were very suggestible is debatable.

E. INTERPRETATION OF EXPERIMENT 9 RESULTS

Organizations that were originally functionally based appeared to be more reluctant to change their organizational structure than those which were originally divisionally based. This may have been because many participants felt that the penalty that might result from a lack of familiarity with new resources would be higher than the gain from reduced coordination requirements, the need to learn (the use of new assets introduces learning curve effects} inhibited the willingness to change. Generalists may be more adaptable than specialists, so warfighters probably ought to be exposed to as broad a range of military capabilities as might be feasible.

Functionally based organizations were relatively better at prosecuting their original congruent missions, which may have strengthened their resistance to change relative to divisionally based organizations.

Coordination requirements was not necessarily perceived by participants as an indicator of organizational incongruence, so the new task graphs did not prompt them to reconsider their resource allocation as much as it merely prompted them to anticipate a requirement for coordination. Coordination and communications requirements were not necessarily perceived by all participants as burdensome; they were occasionally perceived as allowing for more flexibility, especially in an uncertain threat environment.

Some participants recognized the need for change, but did not know how this might be accomplished. Participants did not feel confident enough in their knowledge of organizational structure and performance to suggest meaningful changes.

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IV. FUTURE RECOMMENDATIONS

A. BACKGROUND

When attempting to analyze the thoughts and ideas of participants, researchers must rely on forms and transcriptions of information gathered from participants. Since active participation in the discussions is voluntary, the quality of the results relies heavily on the other data collected from the participants. This means that forms and sheets need to be more thorough and also more amenable to analysis.

1. Participant Preparation

Preparation of the participants must be complete, but must not be too leading, in order to enable subjects to come up with their own ideas and not just reiterate those of the moderators. By providing preparation materials and very self explanatory forms to be filled out by the participants, less interaction by the moderator would be needed; resulting in decreased introduction of bias and the quality of data would be improved.

The materials that participants receive prior to experimental runs sets an important foundation that will affect all aspects of their participation based on their expectations of the experiment. The pre-experiment package sent to participants prior to experiment 9 consisted of a PowerPoint presentation with six slides; title slide, overview slide, mission objectives slide, fundamental task graph slide, friendly order of battle slide, and a slide about adapting organizational structure. If feasible, this PowerPoint presentation should be presented to the participants in a classroom environment. Historically the pool of participants has been from two classes in the Information Sciences Department, and if an hour can be set aside for one of the moderators to present the presentation to the participants, it would provide a forum for them to ask questions about the experiment. Additional information that would be useful to participants prior to the experiment may include a DDD tutorial to decrease the time needed to familiarize the participants with the DDD-III environment, thereby shortening the learning curve for the

benefit of the participants and reducing the learning curve effect for the benefit of the experimental researchers. In past A2C2 experiments, a survey form was used to gather demographic information on the participants. A survey form should be implemented to gain more background on these participants. Willingness and ability to adapt may possibly be correlated with differences in backgrounds, with one possible hypothesis being that individuals with extensive experience in one form of organization or another may have a tendency to be more amenable to changes toward that form of organization, and more resistant to changes away from that form organization. Collecting demographic information on participants may prove useful for comparison with reasons for change stated on an individual level. A suggested Demographic Survey Form is included in Appendix E. Additionally, a DDD-III tutorial document should be included to assist in familiarization with the DDD-III environment prior to actual use; this will increase the proficiency of the participants without increasing the training time in the DDD-III environment.

2. Data Collection Modifications

The iterative design of the A2C2 project provides for design and implementation of changes to the research program over time. As experiments are conducted and analyzed, new ideas can be introduced into the experiment to overcome difficulties and explore different aspects. Additionally, as technology advances, the ability to integrate new features to increase the quality of the data collected can be introduced.

a. Roles and Responsibilities Forms

One specific area of experiment 9 data that proved difficult to analyze was the roles and responsibilities form. With two additional columns for the participants to explicitly state asset transfers with “to” and “from” blocks and direction to fill those blocks in, the data should be more consistent (i.e., prevent the occurrence of an asset being transferred, and either only one or neither of the two stations involved in the

change listing the change, by explicitly listing each asset change as going to or coming from a particular station). Additionally, limit user input to one entry per asset transfer or coordination change in the reason block, if more than one rationale is desired for an asset transfer, additional lines should be used. In several cases in experiment 9, participants listed all reasons given in the list for a single asset transfer, causing imbalances in the data. The final change recommended by the authors to the roles and responsibilities sheets is to provide separators for each of the planning sessions; this should mitigate the difficulty in separating data collection between separate planning sessions. Redesigned role and responsibility sheets and participant instruction handout are included in Appendix F.

b. DDD-III Run Performance Indicators

Observation of experiment 9 showed that the participants had a difficult time determining their overall performance. In some instances, even after being presented with lower than average performance scores in comparison to other teams, participants actually felt that they had performed well. In order for the participants to realize the need for changes based on performance, a better understanding of what performance measures indicate is needed. In the configuration for experiment 9, only two (2) measures are presented in real time: 1) Offense, 2) Defense, and neither one was defined to an extent that the participants would be able to use the values obtained to determine how the organization in place or actions taken actually affected the scores. Introducing a means to provide granular real-time feedback to the system might give the subjects a better idea of how they are actually performing on an individual level. With increased granular performance measures available, the participants may be able to determine changes that could be made on an individual level to improve overall performance. Using only coarse measures, the ability of participants to determine changes that might be made is a very large problem that involves much guesswork and very little actual data assessment, resulting in changes that may or may not have the intended effect.

Access and interpretation of data collected by the DDD is cumbersome and does not provide for low level feedback in real time or even directly after execution of an experiment play. Currently, an SQL database is being designed for integration into the system. The database will reside on a Windows™ based computer and the DDD will transmit data in real time during simulation runs to the database. Centralizing the data output of the DDD in a database will allow for better access to information and should be made accessible though the network. The data sent to the database must be comprehensive and include all of the data parsed from the currently existing files generated by the DDD and must allow the polling of information in real-time. Much of the data collected could be useful for presentation to participants, during or immediately after a play, which would assist them in understanding their actual performance in finer-grained detail and possibly provide better insights as to how their organizational structure and assets might be reconfigured to improve performance.

In order to achieve the granularity needed for individual performance evaluation, the DDD must be modified to provide data that can be used to show performance of individual players and individual sub-platforms. One such modification that might prove very useful would be to add new opportunity and responsibility factors. Opportunity would be defined as: A situation where a threat or task that can be prosecuted when passing through the area of responsibility for an asset, and responsibility would be defined as: A situation where a threat or task threatens an asset within the area of responsibility for asset. In both cases, opportunity and responsibility must only be assessed for platforms and sub-platforms that have the capability to prosecute the task. In order to accomplish this, individual assets could be assigned areas of responsibility. As tasks appear or move into different areas of responsibility, a flag could be set to indicate that a task has passed through his area of responsibility indicating an opportunity, and if the task attacks a friendly asset, another flag could be set indicating responsibility. Ideally, there would be preset areas of responsibility with the capability of implementing changes desired by teams for all mobile assets. Using the coordinate system in place and defining the areas in DDD-III scenario design (.xs) files would enable monitors to input the changes between runs.

c. Dual Monitor Integration and Uses

Another change to be made to the DDD environment is the conversion of the workstations to dual-monitor. Introduction of a second monitor to the interface would provide physical screen space to implement additional features to enhance real-time feedback to the participants during play, providing for better awareness of performance metrics. The additional screen area could be used to provide; a text chat, performance meters, and a notes section.

(1) Text Chat. Communications between stations is a source of data for analysis that requires a lot of effort to collect and organize. With the current system of recording and coding, there are many chances to miss data and improperly code the communication; it also leaves much room for subjective interpretation. Additionally, the use of a single open voice network for all communications can be a cause of distraction for stations, requiring them to filter out information not applicable to them. Implementation of a text based chat client would aid in all these respects.

The text chat client needs to be robust and customizable, to allow for modifications such as logging options and different channels, and use of in lieu of voice chat serves multiple functions to enhance the experiment. Transcription of recorded sessions has been used in the past to construct a written record of communications; this is not completely reliable due to possible errors in transcription introduced by interpretation of the transcriber, errors in recording (missed, end of tape, etc.), and ambiguities due to the ease and availability of an open voice communications channel all too easily employed. Use of a text based chat network would provide a precise record of communications, accurate time stamps, and originator and recipient tags; all information desired for analysis can be logged with the traffic, providing more information for review and analysis. Multiple channels would make it possible to limit communications to sender and receiver, and if possible, eliminate broadcast communications from all stations except DM0. This could be accomplished by implementing five (5) separate chat windows (one window for each of the other stations) or by use of radio buttons to select which station is desired to receive the message with

one chat window. The chat program could include a method for review and addition of coding for each communication and a method for tabulation of all communication traffic between stations, for use in post-experimental analysis.

(2) Performance Indicators. Observations from experiment 9 revealed that the participants had difficulty in understanding the nature and quality of individual and team performance. Inclusion of a display indicating performance by role and team statistics would make actual performance more understandable. The performance display should include both numerical and graphical displays for ease of use. Types of graphical scales to use that provide quick recognition may include colored bars and dials. Emphasis should be placed on having indications of both potential and actual current performance in order to make the difference clearly visible. During design of a new metric and the associated graphical display of performance, the scoring system could be reexamined and changed from the current coarse scoring method, which starts at 100 percent and decrements over the course of the scenario as tasks are not completed with full accuracy, to a new system that starts at zero (0) and increases based on tasks completed. The ratio of actual score to possible score can be displayed numerically to give a percentage score, but all three (3) values need to be visible to the participants to increase awareness of performance levels.

(3) Notes Pane. The final recommendation for the second monitor by the authors is a notes pane: an area available for the participants to type short notes as the simulation is being executed. Use of the notes pane should be left for free form writing, allowing the user to implement any use they deem necessary to assist them in the execution of the session. When the interface is introduced, the notes pane can be presented as a free form section that the participants have available to put notes about observations during the play that they believe should be addressed in the planning sessions, and any other information that could be useful during play.

B. FUTURE SCENARIO DESIGN

Another idea for possible implementation presented by the authors would be to start all teams in a hybrid organization for their first scenario play, and develop a hybrid-congruent scenario. Depending on the number of teams, an effort might be made to maintain a control team that plays against this same scenario, while being allowed to make changes as they deem necessary. The remaining teams would be confronted with scenarios that are either functional or divisional, and also be allowed to make changes to their organization. Determination of a hybrid organization and scenario somewhere between the divisional and functional is not easy task, as current designs available for hybrid organizations may or may not serve as a good starting point. The hybrid organization used in the final hash has individual team members serving in *either* a regional *or* task based role; there was not much of a mix of the two. Future hybrid organizations should try to combine more functional and divisional roles; this should be more conducive to making unbiased changes as the experiment progresses. A future experiment could be designed to develop an unbiased hybrid organization and scenario.

C. SUMMARY

Have more precise metrics of mission accomplishment/failure in order to provide stronger and more meaningful cues to the participants, in order to facilitate discussion of potential changes for those participants who recognized the need for change, but did not know how this might be accomplished. Change the voice communications network to chat windows to make coordination sufficiently onerous for this to be a salient cue to the need for adaptation.

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APPENDIX A

Appendix A contains the documents and forms provided to the teams in support of their scenario play sessions and planning sessions. Included are: Organization Tables, Roles and Responsibilities, and Task Graphs for both divisional and functional starting organizations.

DIVISIONAL ORGANIZATION - ASSET OWNERSHIP TABLE

		CVN	DDGA	CG	DDGC	FFG	DDGB	AOF	FOB
1	GREEN (on CVN)	F18S(a), F18S(b) UAV, HH60 FAB, MH53 F18A(a)+E2C F18A(b)							
2	BLUE (on DDGA)		UAV, HH60 FAB, 2HARP 8TLAM 6SM2						SOF(a)
4	RED (on CG)			8TLAM UAV, HH60 FAB, 2HARP, MH53 6SM2					
6	BROWN (on DDGC)				UAV, HH60 FAB, 2HARP 8TLAM 6SM2				SOF(c)
3	PURPLE (on FFG)					UAV, HH60 FAB, 2HARP, MH53 4SM2		F18S(a), F18S(b) F18A(a)+E2C F18A(b)	
5	ORANGE (on DDGB)						UAV, HH60 FAB, 2HARP 8TLAM 6SM2		SOF(b)
		CVN	DDGA	CG	DDGC	FFG	DDGB	AOF	FOB

ROLES AND RESPONSIBILITIES FOR COMMANDERS IN DIVISIONAL ORGANIZATION

Area A1: ground area *western* half of country A (from 0 to 125mi)
Area A2: ground area *eastern* half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

BLUE: DDGA

- Conduct ground operations in area A1 including use of ISR for mapping requests, locating SML, CDL and SAM sites; SML and SAM site prosecution; **mission tasks including NBW, BR, ABW**; prosecution of any RGF, CDL, etc.
- Obtain STRIKE, ISR and AAW support from GREEN/CVN as needed.
- Provide AAW defense using SM2 in an area ~ 100mi around own ship
- Provide ASuW defense using FAB and HARP in an area ~ 60mi around own ship
- Conduct S&R operations in an area ~ 70mi around own ship
- Coordinate with BROWN/DDGC on overlapping coverage areas.

BROWN: DDGC

- Conduct ground operations in area A2 including use of ISR for mapping requests, locating SML and SAM sites; SML and SAM site prosecution; **mission tasks including C2-CTR, ABE, NBE**; prosecution of any RGF, CDL, etc.
- Obtain STRIKE, ISR and AAW support from GREEN/CVN and PURPLE/FFG as needed.
- Provide AAW defense using SM2 in an area ~ 100mi around own ship
- Provide ASuW defense using FAB and HARP in an area ~ 60mi around own ship
- Conduct S&R operations in an area ~ 70mi around own ship
- Coordinate with BLUE/DDGA and RED/CG on overlapping coverage areas.
- Coordinate with ORANGE/DDGB on tasks in adjacent land areas A2 and B

ORANGE: DDGB

- Conduct ground operations in area B including use of ISR for mapping requests, locating SML and SAM sites; SML and SAM site prosecution; **mission tasks including PORT**; prosecution of any RGF, CDL, etc.
- Obtain STRIKE and AAW support from PURPLE/FFG as needed.
- Obtain ISR support from RED/CG and PURPLE/FFG as needed.
- Provide AAW defense using SM2 in an area ~ 100mi around own ship.
- Provide ASuW defense using FAB and HARP in an area ~ 60mi around own ship
- Conduct S&R operations in an area ~ 70mi around own ship.
- Coordinate with RED/CG and PURPLE/FFG on overlapping coverage areas.
- Coordinate with BROWN/DDGC on tasks in adjacent land areas A2 and B.

GREEN: CVN

- Support BLUE/DDGA and BROWN/DDGC with F18S ground strike operations in areas A1 and A2, including mobile SAM sites (SA3).
- Supported commander for mine clearing operations in an area extending 100mi from the North shore of country A. Coordinate with RED/CG on mine clearing.
- Conduct F18A air defense operations in an area extending 200mi North of countries A and B. Defend E2C. Coordinate AAW with BLUE/DDGA and BROWN/DDGC.
- Provide local ASuW defense using FAB in an area ~ 40mi around own ship.
- Conduct S&R operations in an area ~ 70mi around own ship.
- Conduct ISR in the north of and along shoreline of Country A.
- Support BLUE/DDGA and BROWN/DDGC in conducting ISR in areas A1 and A2.

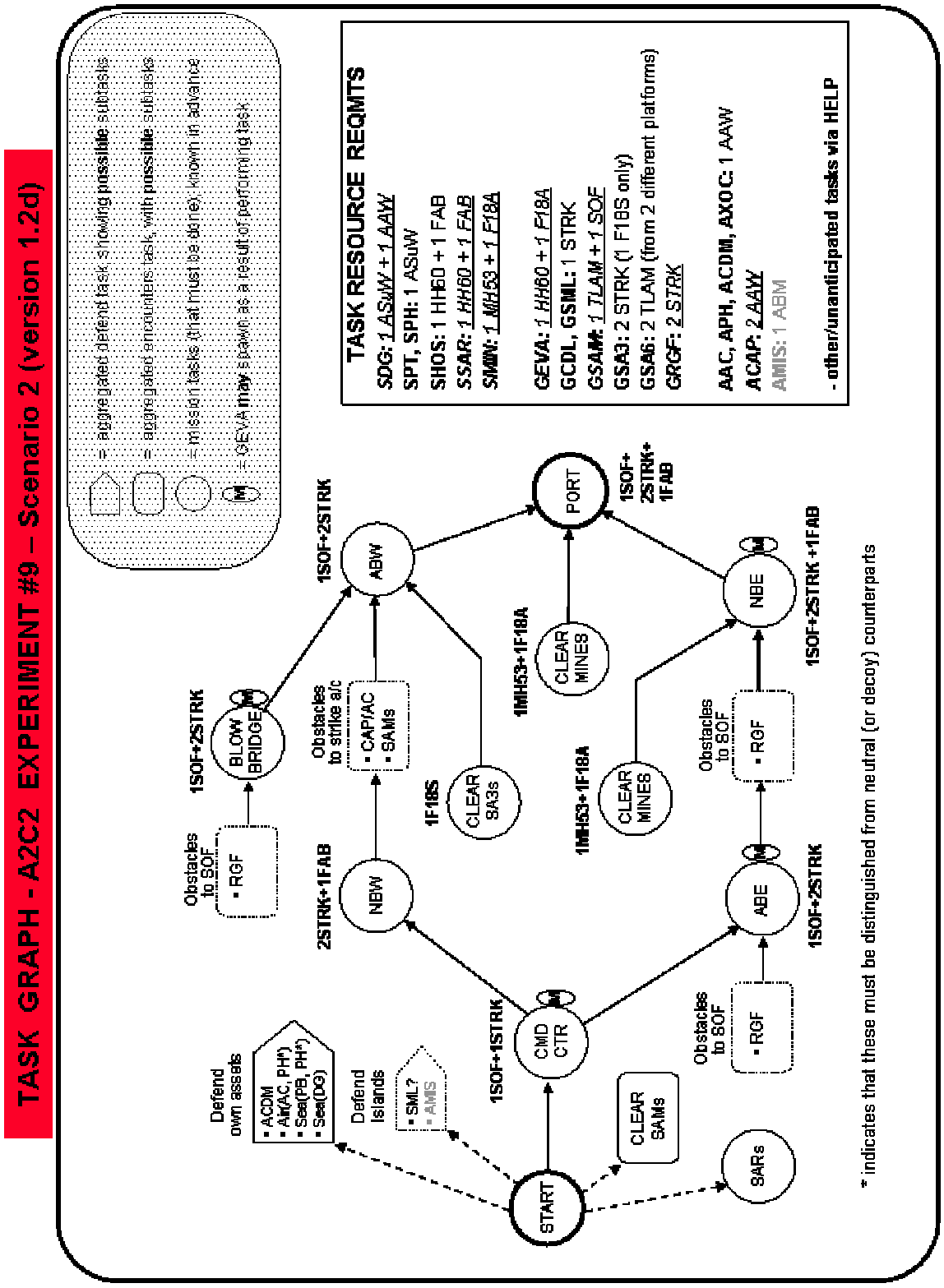
PURPLE: FFG

- Support BROWN/DDGC and ORANGE/DDGB with F18S ground strike operations in areas A2 and B.
- Supported commander for mine clearing operations in an area extending 100mi from the East shore of country B. Coordinate with RED/CG on mine clearing.
- Provide AAW defense using SM2 in an area ~ 100mi around own ship.
- Conduct F18A air defense operations in an area extending ~ 200mi East from the center of country B. Defend E2C. Coordinate AAW with ORANGE/DDGB, RED/CG.
- Provide ASuW defense using HARP and FAB in an area ~ 60mi around own ship
- Conduct S&R operations in an area ~ 70mi around own ship.
- Conduct ISR in the southern half and along shoreline of Country B.
- Support ORANGE/DDGB in conducting ISR in area B.
- Coordinate with ORANGE/DDGB on overlapping/adjacent areas.

RED: CG

- Supporting commander to BLUE/DDGA, BROWN/DDGC and ORANGE/DDGB for TLAM strike operations in areas A1, A2 and B, respectively.
- Supported commander for mine clearing operations in an area extending 100mi from the North shore of country B. Coordinate with PURPLE/FFG and GREEN/CVN.
- Provide AAW defense using SM2 in an area ~ 100mi around own ship
- Provide ASuW defense using FAB and HARP in an area ~ 60mi around own ship
- Conduct S&R operations in an area ~ 70mi around own ship
- Conduct ISR in the northern half of Country B and along north and east shorelines.
- Support BROWN/DDGC and ORANGE/DDGB in conducting ISR in areas A2 and B
- Coordinate with BROWN/DDGC and ORANGE/DDGB in overlapping areas.

INITIAL DIVISIONAL TASK GRAPH



FUNCTIONAL ORGANIZATION - ASSET OWNERSHIP TABLE

		CVN	DDGA	CG	DDGC	FFG	DDGB	AOF	FOB
1	GREEN (on CVN)	F18S(a), F18S(b)	8TLAM	8TLAM	8TLAM		8TLAM	F18S(a), F18S(b)	
2	BLUE (on DDGA)	HH60	HH60	HH60	HH60	HH60	HH60		
4	RED (on CG)	F18A(a)+E2C F18A(b)	6SM2	6SM2	6SM2	4SM2	6SM2	F18A(a)+E2C F18A(b)	
6	BROWN (on DDGC)								SOF(a) SOF(b) SOF(c)
3	PURPLE (on FFG)	UAV	UAV	UAV	UAV	UAV	UAV		
5	ORANGE (on DDGB)	FAB, MH53	FAB, 2HARP	FAB, 2HARP, MH53	FAB, 2HARP	FAB, 2HARP, MH53	FAB, 2HARP		
		CVN	DDGA	CG	DDGC	FFG	DDGB	AOF	FOB

ROLES AND RESPONSIBILITIES FOR COMMANDERS IN FUNCTIONAL ORGANIZATION

BLUE: SAR (located on DDGA)

- Using HH60s conduct all S&R operations theater-wide
- Obtain support from ORANGE/SuWC or RED/AWC as might be needed for any combat S&R tasks

BROWN: SOF (located on DDGC)

- Provide SOF support to all ground tasks that have a SOF requirement, especially mission tasks
- Coordinate with GREEN/STRIKE to illuminate/designate tasks and/or mount joint attacks as may be required

PURPLE: ISR (located on FFG)

- *Use UAVs to respond to all ISR tasks in a timely manner.* These include terrain mapping tasks and early detection/localization of SCUD-missile launchers (SML).
- Illuminate SCUD launchers to allow attack by available STRIKE assets
- Detect & illuminate CDLs and coordinate with GREEN/STRIKE to attack
- Discover SAM sites while avoiding having your UAVs shot down

GREEN: STRIKE (located on CVN)

- Apply strike assets (TLAM, F18S) to process all tasks that include STRIKE requirements, especially mission tasks
- Destroy SAM sites north of 325, esp those that hinder ingress of F18S and UAV
- Coordinate with BROWN/SOF or PURPLE/ISR as may be required (for task illumination or joint attack)

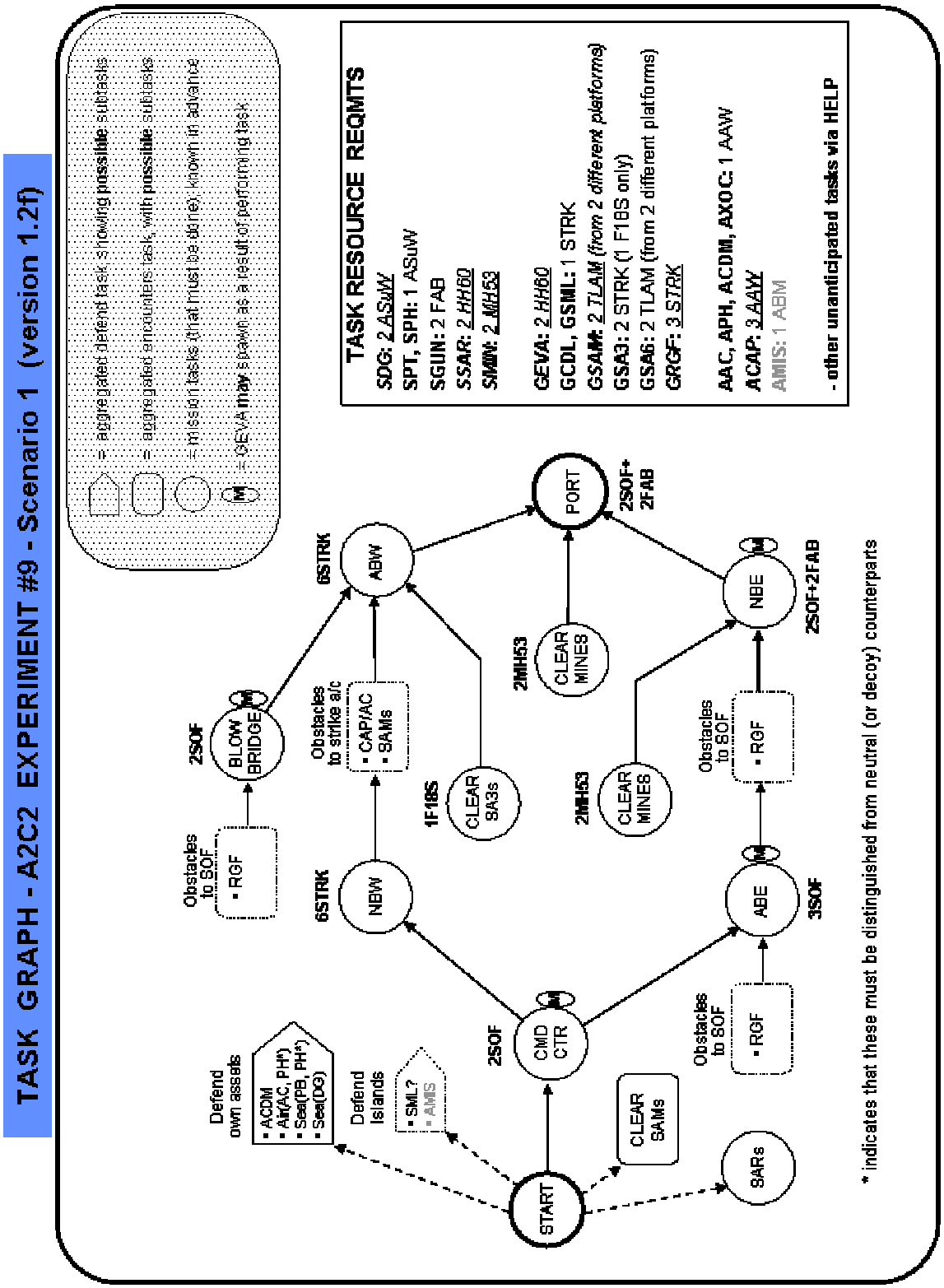
ORANGE: SuWC/MINES (located on DDGB)

- Using HARP and FAB provide surface defense theater-wide against SPT and SDG
- Provide support via FAB for any tasks that have an ASuW requirement, including mission tasks, unanticipated tasks, or combat S&R
- Use FAB to determine if possible hostile surface craft (SPH) are indeed hostile or not
- Responsible for all mine-clearing operations theater-wide.
- Coordinate with RED/AWC as might be required to assist/protect MH53s and/or FABs.

RED: AWC (located on CG)

- Using SM2 and F18A provide all air defense theater-wide against AAC, ACAP
- Protect assets against incoming CDL-missiles, and SDG-fired exocets
- Provide support via F18A for any tasks that have an AAW requirement, including mission tasks, unanticipated tasks, combat S&R, asset protection, etc.
- Use F18A to determine if possible hostile aircraft (APH) are indeed hostile or not
- Coordinate with ORANGE as might be required to assist/protect MH53s and/or FABs.

INITIAL FUNCTIONAL TASK GRAPH



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APPENDIX B

RATIONALE for CHANGING ROLES and RESPONSIBILITIES

Roles and/or responsibilities of a player will change if assets owned by that player change, or if task requirements change. Some roles are independent of assets owned, such as those of a coordinator, yet may change as the team adopts new task processing strategies.

In the accompanying ROLES AND RESPONSIBILITIES worksheet we are asking you to denote each *change* being made to *your* prior roles and responsibilities, the assets (if any) that are needed to support the changed role, and the major reasons motivating/driving the change, by code. If *no changes* at all are made to any of your R&Rs, please provide the rationale as well.

Several rationales for change include, but are not necessarily limited to:

BW: BALANCE WORKLOAD: To more equitably distribute task processing and/or asset management workload among players.

RC: REDUCE COORDINATION DEMANDS: To reduce the amount of coordination required to perform tasks, e.g., organize around tasks.

CM: ADD COORDINATION MECHANISMS: To provide a coordinator or integrator for one or more kinds of tasks.

SA: IMPROVE SITUATIONAL AWARENESS: To improve SA via (re)defining commanders' Area of Responsibility or Area of Regard.

SR: IMPROVE SPEED OF RESPONSE: To improve team responsiveness, especially for time-critical tasks.

UT: POSITION TEAM TO HANDLE UNANTICIPATED TASKS: To better accommodate unanticipated tasks/events, or surprise enemy tactics.

AU: IMPROVE EFFICIENCY IN ASSET UTILIZATION: To make better use of available assets for tasks processing.

PC: ADJUST TO PLAYERS' CAPABILITIES: To take advantage of a player's skills and/or competencies; compensate for a player's deficiency.

O: OTHER: You may have other reasons driving your change. If so, please indicate them on the reverse of the Roles & Responsibilities worksheet.

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APPENDIX C

1. Excel Files Derived from .Dep files.

Functional Task Definitions

ID	TYPE	SYMBOL	
0	G	NBE	Naval base -East
1	G	NBW	Naval Base - West
2	G	CMD	Enemy command center
3	S	DG	Destroyer /w missiles/mines
4	S	PT	Fast Patrol/Missile Craft
5	G	CDL	Coastal Defense Launcher
6	G	SML	SCUD msl Launcher
7	A	AC	Aircraft attack wave
8	G	ABE	Air Base - East
9	G	ABW	Air Base - West
10	G	SAM	SAM site -fixed
11	A	NU	commercial air
12	S	NU	white/merchant ship
13	A	CDM	CD cruise missile
14	A	MIS	SCUD - launched missile
15	S	MIN	sea mines
16	A	XOC	exocet fired at blue ships
17	A	PH	air possible hostile - y
18	A	PH	air possible hostile - n
19	S	PH	ship possible hostile - y
20	S	PH	ship possible hostile - n
21	G	SA3	mobile SAM site
22	G	EW	possible SCUD launch
23	S	S&R	basic rescue effort at sea
24	A	REC	red recon aircraft
25	G	RGF	red ground force
26	G	SML	SCUD 2nd msl launcher
27	S	S&R	indicates nothing there
28	G	BR	major bridge
29	G	PRT	final objective - secure Port
30	G	TSK	high priority complex task
31	S	TSK	high priority complex task
32	G	TSK	high priority complex task
33	G	EVA	evacuate wounded
34	S	GUN	gun runners
35	G	NBE	shows done NBE
36	G	NBW	shows done NBW
37	A	CAP	aircraft attacker/defender
38	G	ABE	shows done ABE
39	G	ABW	shows done ABW
40	G	SA6	SAM cluster - fixed

Divisional Task Definitions

ID	TYPE	SYMBOL	
0	G	NBE	Naval base -East
1	G	NBW	Naval Base - West
2	G	CMD	Enemy command center
3	S	DG	Destroyer /w missiles/mines
4	S	PT	Fast Patrol/Missile Craft
5	G	CDL	Coastal Defense Launcher
6	G	SML	SCUD msl Launcher
7	A	AC	Aircraft attack wave
8	G	ABE	Air Base - East
9	G	ABW	Air Base - West
10	G	SAM	SAM site -fixed
11	A	NU	commercial air
12	S	NU	white/merchant ship
13	A	CDM	CD cruise missile
14	A	MIS	SCUD - launched missile
15	S	MIN	sea mines
16	A	XOC	exocet fired at blue ships
17	A	PH	air possible hostile - y
18	A	PH	air possible hostile - n
19	S	PH	ship possible hostile - y
20	S	PH	ship possible hostile - n
21	G	SA3	mobile SAM site
22	G	EW	possible SCUD launch
23	S	S&R	basic rescue effort at sea
24	A	REC	red recon aircraft
25	G	RGF	red ground force
26	G	SML	SCUD 2nd msl launcher
27	S	S&R	indicates nothing there
28	G	BR	major bridge
29	G	PRT	final objective - secure Port
30	G	TSK	high priority complex task
31	S	TSK	high priority complex task
32	G	TSK	high priority complex task
33	G	EVA	evacuate wounded
34	S	HOS	hostage taker
35	G	NBE	shows done NBE
36	G	NBW	shows done NBW
37	A	CAP	aircraft attacker/defender
38	G	ABE	shows done ABE
39	G	ABW	shows done ABW
40	G	SA6	SAM cluster - fixed

Dep file E9_teamA1d

Team Name: A
Experiment E9_teamA1d
Number of tasks arived: 175

Number of task arrivals by task class	Number of initiated attacks by each dm on various task classes						Number of assisted attacks by each dm on various task classes						Number of contacts (collisions) by each dm on various task classes						Number of penetrations on PZ's by task classes		Number of attacks on various task classes	Average attack latency time on various task classes
1	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	1512.5
1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	660.5
1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	191.5
3	1	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	3	297.17
13	0	2	2	2	2	1	0	0	0	0	0	0	3	0	0	0	0	2	0	0	9	352.33
13	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	57
10	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	47.5
13	0	2	2	2	1	3	0	0	0	0	0	0	1	1	0	1	2	1	0	0	10	178.95
1	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	401.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
11	0	1	0	1	0	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	4	963.38
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
10	0	2	3	1	0	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	8	40.44
13	0	1	0	2	3	2	0	0	0	0	0	0	0	0	0	0	0	0	4	1	8	113.69
7	3	0	2	1	0	0	3	0	0	1	0	0	0	1	0	0	0	0	0	0	6	506
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	1	173
4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	80.25
3	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	461.67
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	999
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	1	1	1	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	4	267.88
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	0	1	0	0	0	2	0	1	0	0	0	2	0	0	0	0	0	0	0	0	3	560.83
8	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	48.75
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	941
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	165
2	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	239
2	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2	420.75
2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	628.5
2	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	178
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	999

Dep file E9_teamA2f

Team Name: A
Experiment E9_teamA2f
Number of tasks arived: 179

Number of task arrivals by task class	Number of initiated attacks by each dm on various task classes						Number of assisted attacks by each dm on various task classes						Number of contacts (collisions) by each dm on various task classes						Number of penetrations on PZ's by task classes		Number of attacks on various task classes	Average attack latency time on various task classes
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1117.5
1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	147.5
7	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	56.5
12	1	1	0	4	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	8	382.25
13	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	67
10	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	55
17	0	2	0	2	1	0	0	0	0	0	0	0	3	0	3	3	2	3	0	0	5	149.4
1	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	287
1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	1946
11	0	3	0	0	4	0	0	2	0	0	4	0	0	0	0	0	1	0	0	0	7	804.57
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
12	1	2	0	2	2	2	0	0	0	0	0	0	0	0	2	0	0	1	0	0	9	41.78
8	0	0	0	2	2	2	0	0	0	0	1	0	0	0	0	0	0	0	0	2	6	115.08
5	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	2	1351.25
5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	2	0	0	0	999
4	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	110
4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	243.25
4	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	276.5
4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	368.5
1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1572
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	319.33
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	3	518.83
5	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	63.75
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	667
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	173.5
2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	80
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	1	0	0	1	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	2	169.75

Dep file E9_teamB1f

Team Name: B
Experiment E9_teamB1f
Number of tasks arived: 181

Number of task arrivals by task class	Number of initiated attacks by each dm on various task classes						Number of assisted attacks by each dm on various task classes						Number of contacts (collisions) by each dm on various task classes						Number of penetrations on PZ's by task classes		Number of attacks on various task classes	Average attack latency time on various task classes
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1089
1	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	135.5
7	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	458
12	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	2	1	2	0	0	0	999
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
10	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	42.5
15	0	0	0	12	0	0	0	0	0	0	0	0	2	1	0	6	0	0	0	0	12	149.46
1	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	1027
1	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1973
11	3	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	3	836.17
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
13	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	10	40.75
9	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	8	97.75
5	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3	667
6	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	2	2	2	0	0	2	12.5
4	0	0	0	2	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	2	125.25
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	999
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1521
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	6	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	6	195.42
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1253.67
6	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	67.33
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1356
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	498.5
2	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	227.75
2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	209.5
2	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	488
2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	261.5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	265.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	2	274.75

Dep file E9_teamB2d

Team Name: B
Experiment E9_teamB2d
Number of tasks arived: 167

Number of task arrivals by task class	Number of initiated attacks by each dm on various task classes						Number of assisted attacks by each dm on various task classes						Number of contacts (collisions) by each dm on various task classes						Number of penetrations on PZ's by task classes		Number of attacks on various task classes	Average attack latency time on various task classes
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1357
1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	309
4	0	0	0	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	259.5
13	0	0	0	0	3	0	0	0	0	0	0	0	2	1	1	1	1	3	0	0	3	430.17
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
10	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	50.2
11	0	0	0	8	0	0	0	0	0	0	0	0	2	1	1	2	0	1	0	0	8	170.19
1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1033
1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1677.5
11	7	0	0	0	0	0	0	0	0	0	0	7	1	0	0	0	0	0	0	0	7	1204.79
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
13	0	0	0	8	0	0	0	0	0	0	0	0	1	1	2	0	0	1	0	0	8	36.62
6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	100.42
7	0	0	0	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	5	446.2
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	999
3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1	0	0	0	0	999
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	999
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1188
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	187.25
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1146.67
5	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	68
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1506
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	171
2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	463
2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	478.5
2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	341.25
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	154.75
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	132

Dep file E9_teamC1d

Team Name: C
Experiment E9_teamC1d
Number of tasks arived: 168

Number of task arrivals by task class	Number of initiated attacks by each dm on various task classes						Number of assisted attacks by each dm on various task classes						Number of contacts (collisions) by each dm on various task classes						Number of penetrations on PZ's by task classes		Number of attacks on various task classes	Average attack latency time on various task classes
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	218
3	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	411
13	0	2	1	2	0	3	0	0	0	0	0	0	2	0	0	1	1	0	0	0	8	278.19
13	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	40
10	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	37.75
13	0	1	2	3	0	3	0	0	0	0	0	0	3	1	1	0	0	1	0	0	9	167.56
1	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	1036.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
11	0	1	0	0	1	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	2	1384
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
12	0	2	1	2	2	2	0	0	0	0	0	0	2	0	1	0	0	0	0	0	9	27.94
9	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	8	106.81
7	3	0	2	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	5	684.2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	148.25
4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	93.5
3	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2	363.5
4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	154
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	1	0	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	3	423
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	2	0	0	0	0	1	0	0	0	0	0	1	0	2	0	0	0	0	0	0	3	1043.67
6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	35
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1627.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	565
2	0	0	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	2	409.75
2	0	0	2	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	2	424
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	289.5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	999

Dep file E9_teamC2F

Team Name: C
Experiment E9_teamC2f
Number of tasks arived: 177

Number of task arrivals by task class	Number of initiated attacks by each dm on various task classes						Number of assisted attacks by each dm on various task classes						Number of contacts (collisions) by each dm on various task classes						Number of penetrations on PZ's by task classes		Number of attacks on various task classes	Average attack latency time on various task classes
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1210.5
1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	162
5	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	209
12	0	2	2	3	0	3	0	0	0	0	0	0	1	0	1	0	0	0	0	0	10	417.9
13	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	83.5
10	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	39.75
15	1	2	2	1	2	1	0	0	0	0	0	0	3	0	3	3	0	1	0	0	9	140.44
1	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	928
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
11	0	1	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	1	0	0	2	1297
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
12	0	2	2	2	2	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	10	32.4
11	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	9	110.06
5	0	0	0	2	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	2	1182.25
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	999
4	1	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	79.83
4	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	186.5
4	0	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	440.17
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	2	0	2	2	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	6	354.08
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	1	2	0	0	0	0	0	1	1	0	0	2	0	0	0	0	0	1	0	0	3	1243.17
8	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	45.38
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1450.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	430
2	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	443
2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	134
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	361
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	1	190.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	999

Dep file E9_teamD1f

Team Name: D
Experiment E9_teamD1f
Number of tasks arived: 152

Number of task arrivals by task class	Number of initiated attacks by each dm on various task classes						Number of assisted attacks by each dm on various task classes						Number of contacts (collisions) by each dm on various task classes						Number of penetrations on PZ's by task classes		Number of attacks on various task classes	Average attack latency time on various task classes
1	0	0	0	0	0	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	1217
1	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	473
1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	120.5
3	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	338.33
11	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	10	276.95
10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	68.67
9	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	56.5
14	0	0	0	12	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	12	97.83
1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	387
1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1093.5
11	6	0	0	0	0	0	4	0	0	0	0	0	1	0	0	0	0	0	0	0	6	367.58
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5	27.3
6	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	114.58
5	0	2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	2	1120
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	3	72.17
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	338.75
4	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	321
1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	852.5
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4	243.88
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	708.83
5	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	55.12
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	849.5
1	0	0	0	0	0	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	1571.5
1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	150
2	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	121.5
2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	84.75
2	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	425.75
2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	149
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	257.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	527.5

Dep file E9_teamD2d

Team Name: D
Experiment E9_teamD2d
Number of tasks arived: 157

Number of task arrivals by task class	Number of initiated attacks by each dm on various task classes						Number of assisted attacks by each dm on various task classes						Number of contacts (collisions) by each dm on various task classes						Number of penetrations on PZ's by task classes		Number of attacks on various task classes	Average attack latency time on various task classes
1	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1371
1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	650.5
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	197.5
4	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	257.5
13	0	0	0	0	12	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	12	246.96
13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	81.5
10	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	49.5
11	0	0	0	9	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	9	120.67
1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	665.5
1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1244
11	0	0	0	0	0	8	0	0	0	0	0	4	0	0	0	0	0	0	0	0	8	849.5
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
12	0	0	0	7	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	7	33.93
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
7	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	4	378.62
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	999
3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	105.5
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	313.33
4	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	300.83
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1029.5
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	3	0	0	2	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	5	306.3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	867.83
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	936.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	100.5
2	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	465.5
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	538
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1	143.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	278.25

Dep file E9_teamE1d

Team Name: E
Experiment E9_teamE1d
Number of tasks arived: 154

Number of task arrivals by task class	Number of initiated attacks by each dm on various task classes						Number of assisted attacks by each dm on various task classes						Number of contacts (collisions) by each dm on various task classes						Number of penetrations on PZ's by task classes		Number of attacks on various task classes	Average attack latency time on various task classes
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	565
1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	123.5
5	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	197.25
13	0	1	0	3	3	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	8	359.56
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
9	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	50
13	1	0	0	2	2	1	0	0	0	0	0	0	1	0	0	0	1	1	0	0	6	194.17
1	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	695
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
11	0	2	0	0	0	2	0	2	0	0	0	2	0	0	0	0	0	0	0	0	4	1143.88
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
8	0	1	0	1	3	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	5	41.6
5	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	75.5
7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4	574.38
2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	999
3	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	1	128
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	511.5
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1584.5
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	265
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	429.5
3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	58
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	368.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	162.5
2	0	1	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	449.25
2	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	262.5
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	333
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	147.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	1	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0	0	1	1273

Dep file E9_teamE2f

Team Name: E

Experiment condition: E9_teamE2f

Number of tasks arived: 179

Number of task arrivals by task class	Number of initiated attacks by each dm on various task classes						Number of assisted attacks by each dm on various task classes						Number of contacts (collisions) by each dm on various task classes						Number of penetrations on PZ's by task classes		Number of attacks on various task classes	Average attack latency time on various task classes
1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1374.5
1	0	1	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	1	169
1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	85
6	0	0	0	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	192.5
12	0	2	0	4	1	3	0	0	0	0	0	0	0	0	2	1	0	0	0	0	10	394.6
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
10	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	50.17
15	2	1	0	2	4	2	0	0	0	0	0	0	7	0	0	0	3	0	0	0	11	129.09
1	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	413
1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1300
11	0	1	2	2	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	5	1223.7
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
13	0	1	0	2	3	2	0	0	0	0	0	0	2	1	2	0	0	0	0	0	8	31
9	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	5	113.3
5	0	0	0	0	4	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	4	510.12
3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	999
4	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2	67.5
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
4	0	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	394.5
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	914
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
6	0	0	0	1	2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	3	384.5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
3	0	3	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	3	791.33
7	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	38.7
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	869
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	301
2	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	342.5
2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	185.5
2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	229
2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	540
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	311.5
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	999
2	0	2	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0	0	2	474

APPENDIX D

1. Data Table (Question 4)

			Rationale Cited									
Session	**Color**	**Team**	**BW**	**RC**	**CM**	**SA**	**SR**	**UT**	**AU**	**PC**	**O**	**Total Number of Reasons Cited**
1	**Blue**	**A**	1	1	0	0	0	2	0	0	0	4
1	**Red**	**A**	1	3	0	0	0	0	1	0	0	5
1	**Green**	**A**	1	0	0	0	0	0	0	0	0	1
1	**Purple**	**A**	1	0	0	0	0	1	0	0	0	2
1	**Brown**	**A**	0	1	0	0	0	0	1	0	2	4
1	**Orange**	**A**	0	0	2	0	0	2	0	0	0	4
2	**Red**	**A**	1	0	0	0	0	0	0	0	0	1
2	**Purple**	**A**	2	0	2	5	7	0	6	0	0	22
2	**Orange**	**A**	3	3	2	3	0	0	0	0	0	11
2	**Brown**	**A**	0	1	0	6	0	0	4	0	0	11
2	**Green**	**A**	0	1	0	0	1	0	1	0	0	3
2	**Blue**	**A**	0	0	1	0	1	0	1	0	0	3
3	**Blue**	**A**	0	0	0	0	0	0	0	1	0	1
3	**Brown**	**A**	0	0	0	0	0	0	0	0	0	0
3	**Green**	**A**	0	0	0	0	0	0	0	0	0	0
3	**Orange**	**A**	0	0	0	0	1	0	0	0	0	1
3	**Purple**	**A**	0	0	0	0	2	0	0	0	0	2
3	**Red**	**A**	0	0	0	0	0	0	0	0	0	0
1	**Red**	**C**	1	1	0	0	0	0	0	0	0	2
1	**Brown**	**C**	0	1	0	1	1	0	0	0	0	3
1	**Blue**	**C**	0	0	0	0	1	0	1	0	0	2
1	**Green**	**C**	0	0	0	0	0	0	0	0	2	2
1	**Orange**	**C**	0	0	0	1	0	0	1	0	0	2
1	**Purple**	**C**	0	0	0	0	0	0	0	0	0	0
2	**Purple**	**C**	1	1	1	1	1	1	1	1	1	9
2	**Red**	**C**	1	2	0	0	0	0	0	0	0	3
2	**Brown**	**C**	2	0	0	1	1	0	1	0	0	5
2	**Green**	**C**	3	3	0	0	1	0	0	0	0	7
2	**Orange**	**C**	0	1	0	0	1	0	1	0	0	3
2	**Blue**	**C**	0	2	0	0	0	0	0	0	0	2
3	**Purple**	**C**	1	1	1	1	1	1	1	1	1	9
3	**Green**	**C**	3	3	0	0	1	0	0	0	0	7
3	**Red**	**C**	0	2	0	0	0	0	0	0	0	2
3	**Blue**	**C**	0	0	0	0	0	0	1	0	0	1
3	**Brown**	**C**	0	0	0	0	0	0	0	0	0	0

3	**Orange**	**C**	0	0	0	0	0	0	0	0	0	0
1	**Orange**	**E**	1	1	0	0	1	0	0	0	0	3
1	**Blue**	**E**	1	0	0	0	0	0	0	0	0	1
1	**Brown**	**E**	1	0	0	0	1	0	3	0	0	5
1	**Red**	**E**	2	0	0	0	0	0	0	0	0	2
1	**Green**	**E**	5	5	0	0	0	0	0	0	0	10
1	**Purple**	**E**	0	0	3	0	0	0	3	0	0	6
2	**Green**	**E**	1	1	0	0	0	0	0	0	0	2
2	**Blue**	**E**	1	0	0	0	0	0	1	0	0	2
2	**Red**	**E**	3	0	0	0	0	0	0	0	0	3
2	**Orange**	**E**	0	1	1	0	1	1	0	0	0	4
2	**Purple**	**E**	0	0	1	0	0	0	1	0	0	2
2	**Brown**	**E**	0	0	0	0	0	0	0	0	0	0
3	**Red**	**E**	1	0	0	0	0	0	0	0	0	1
3	**Blue**	**E**	2	0	0	1	0	0	0	0	0	3
3	**Purple**	**E**	0	0	2	0	0	0	2	0	0	4
3	**Brown**	**E**	0	0	0	0	0	0	0	0	0	0
3	**Green**	**E**	0	0	0	0	0	0	0	0	0	0
3	**Orange**	**E**	0	0	0	0	0	0	0	0	0	0
1	**Purple**	**B**	1	0	1	0	1	0	0	0	0	3
1	**Brown**	**B**	1	0	0	0	0	0	0	0	0	1
1	**Green**	**B**	1	0	0	0	0	0	0	0	0	1
1	**Orange**	**B**	1	0	0	0	0	0	0	0	0	1
1	**Blue**	**B**	0	0	0	0	0	0	0	1	0	1
1	**Red**	**B**	0	0	0	0	0	0	0	0	1	1
2	**Blue**	**B**	1	0	0	0	0	0	0	0	0	1
2	**Brown**	**B**	1	0	0	0	0	0	0	0	0	1
2	**Orange**	**B**	1	0	0	0	0	0	0	0	0	1
2	**Purple**	**B**	1	0	0	1	1	0	0	0	0	3
2	**Green**	**B**	0	1	0	0	0	1	0	0	0	2
2	**Red**	**B**	0	0	0	0	0	0	0	0	1	1
3	**Blue**	**B**	1	0	0	0	0	0	0	0	0	1
3	**Brown**	**B**	1	0	0	0	0	0	0	0	0	1
3	**Purple**	**B**	1	0	0	0	1	0	1	0	0	3
3	**Green**	**B**	0	1	0	0	0	0	0	0	0	1
3	**Orange**	**B**	0	0	0	0	0	0	1	0	0	1
3	**Red**	**B**	0	0	0	0	0	0	0	0	1	1
1	**Blue**	**D**	1	1	0	0	0	0	0	0	0	2
1	**Orange**	**D**	1	0	0	0	1	0	1	0	0	3
1	**Brown**	**D**	0	0	0	0	0	0	0	0	0	0
1	**Green**	**D**	0	0	0	0	0	0	0	0	0	0
1	**Purple**	**D**	0	0	0	0	1	0	0	0	0	1
1	**Red**	**D**	0	0	0	0	0	0	1	0	0	1
2	**Green**	**D**	0	1	1	0	1	0	0	0	0	3
2	**Blue**	**D**	0	0	1	0	0	0	0	0	0	1
2	**Orange**	**D**	0	0	3	0	0	0	2	0	0	5

2	**Brown**	**D**	0	0	0	0	0	1	0	0	0	1
2	**Purple**	**D**	0	0	0	0	1	0	0	0	0	1
2	**Red**	**D**	0	0	0	0	0	0	0	0	0	0
3	**Blue**	**D**	0	0	0	0	0	0	0	0	0	0
3	**Brown**	**D**	0	0	0	0	0	0	0	0	0	0
3	**Green**	**D**	0	0	0	0	0	0	0	0	0	0
3	**Orange**	**D**	0	0	0	0	0	0	0	0	0	0
3	**Purple**	**D**	0	0	0	0	0	0	0	0	0	0
3	**Red**	**D**	0	0	0	0	0	0	0	0	0	0
	Average	**Div**	0.741	0.648	0.296	0.370	0.426	0.148	0.574	0.056	0.111	3.370
		Func	0.361	0.111	0.167	0.028	0.194	0.056	0.167	0.028	0.083	1.194
	Variance	**Div**	1.177	1.176	0.477	1.294	1.079	0.204	1.306	0.053	0.176	14.917
		Func	0.237	0.102	0.314	0.028	0.161	0.054	0.200	0.028	0.079	1.304
Two tail student's t-test w/unequal variance - probability			0.0270	0.0011	0.3307	0.0336	0.1431	0.2060	0.0208	0.5098	0.7075	0.0002

2. Data Table (Questions 5, 6 and 7)

			Rationale Cited									
Team	**Color**	**Session**	**BW**	**RC**	**CM**	**SA**	**SR**	**UT**	**AU**	**PC**	**O**	**Total Number of Reasons Cited**
A	**Blue**	**1**	1	1	0	0	0	2	0	0	0	4
A	**Red**	**1**	1	3	0	0	0	0	1	0	0	5
A	**Green**	**1**	1	0	0	0	0	0	0	0	0	1
A	**Purple**	**1**	1	0	0	0	0	1	0	0	0	2
A	**Brown**	**1**	0	1	0	0	0	0	1	0	2	4
A	**Orange**	**1**	0	0	2	0	0	2	0	0	0	4
C	**Red**	**1**	1	1	0	0	0	0	0	0	0	2
C	**Brown**	**1**	0	1	0	1	1	0	0	0	0	3
C	**Blue**	**1**	0	0	0	0	1	0	1	0	0	2
C	**Green**	**1**	0	0	0	0	0	0	0	0	2	2
C	**Orange**	**1**	0	0	0	1	0	0	1	0	0	2
C	**Purple**	**1**	0	0	0	0	0	0	0	0	0	0
E	**Orange**	**1**	1	1	0	0	1	0	0	0	0	3
E	**Blue**	**1**	1	0	0	0	0	0	0	0	0	1
E	**Brown**	**1**	1	0	0	0	1	0	3	0	0	5
E	**Red**	**1**	2	0	0	0	0	0	0	0	0	2
E	**Green**	**1**	5	5	0	0	0	0	0	0	0	10
E	**Purple**	**1**	0	0	3	0	0	0	3	0	0	6
B	**Purple**	**1**	1	0	1	0	1	0	0	0	0	3
B	**Brown**	**1**	1	0	0	0	0	0	0	0	0	1
B	**Green**	**1**	1	0	0	0	0	0	0	0	0	1
B	**Orange**	**1**	1	0	0	0	0	0	0	0	0	1
B	**Blue**	**1**	0	0	0	0	0	0	0	1	0	1
B	**Red**	**1**	0	0	0	0	0	0	0	0	1	1
D	**Blue**	**1**	1	1	0	0	0	0	0	0	0	2
D	**Orange**	**1**	1	0	0	0	1	0	1	0	0	3
D	**Brown**	**1**	0	0	0	0	0	0	0	0	0	0
D	**Green**	**1**	0	0	0	0	0	0	0	0	0	0
D	**Purple**	**1**	0	0	0	0	1	0	0	0	0	1
D	**Red**	**1**	0	0	0	0	0	0	1	0	0	1
A	**Red**	**2**	1	0	0	0	0	0	0	0	0	1
A	**Purple**	**2**	2	0	2	5	7	0	6	0	0	22
A	**Orange**	**2**	3	3	2	3	0	0	0	0	0	11
A	**Brown**	**2**	0	1	0	6	0	0	4	0	0	11
A	**Green**	**2**	0	1	0	0	1	0	1	0	0	3
A	**Blue**	**2**	0	0	1	0	1	0	1	0	0	3
C	**Purple**	**2**	1	1	1	1	1	1	1	1	1	9
C	**Red**	**2**	1	2	0	0	0	0	0	0	0	3
C	**Brown**	**2**	2	0	0	1	1	0	1	0	0	5
C	**Green**	**2**	3	3	0	0	1	0	0	0	0	7
C	**Orange**	**2**	0	1	0	0	1	0	1	0	0	3
C	**Blue**	**2**	0	2	0	0	0	0	0	0	0	2

E	**Green**	**2**	1	1	0	0	0	0	0	0	0	2
E	**Blue**	**2**	1	0	0	0	0	0	1	0	0	2
E	**Red**	**2**	3	0	0	0	0	0	0	0	0	3
E	**Orange**	**2**	0	1	1	0	1	1	0	0	0	4
E	**Purple**	**2**	0	0	1	0	0	0	1	0	0	2
E	**Brown**	**2**	0	0	0	0	0	0	0	0	0	0
B	**Blue**	**2**	1	0	0	0	0	0	0	0	0	1
B	**Brown**	**2**	1	0	0	0	0	0	0	0	0	1
B	**Orange**	**2**	1	0	0	0	0	0	0	0	0	1
B	**Purple**	**2**	1	0	0	1	1	0	0	0	0	3
B	**Green**	**2**	0	1	0	0	0	1	0	0	0	2
B	**Red**	**2**	0	0	0	0	0	0	0	0	1	1
D	**Green**	**2**	0	1	1	0	1	0	0	0	0	3
D	**Blue**	**2**	0	0	1	0	0	0	0	0	0	1
D	**Orange**	**2**	0	0	3	0	0	0	2	0	0	5
D	**Brown**	**2**	0	0	0	0	0	1	0	0	0	1
D	**Purple**	**2**	0	0	0	0	1	0	0	0	0	1
D	**Red**	**2**	0	0	0	0	0	0	0	0	0	0
A	**Blue**	**3**	0	0	0	0	0	0	0	1	0	1
A	**Brown**	**3**	0	0	0	0	0	0	0	0	0	0
A	**Green**	**3**	0	0	0	0	0	0	0	0	0	0
A	**Orange**	**3**	0	0	0	0	1	0	0	0	0	1
A	**Purple**	**3**	0	0	0	0	2	0	0	0	0	2
A	**Red**	**3**	0	0	0	0	0	0	0	0	0	0
C	**Purple**	**3**	1	1	1	1	1	1	1	1	1	9
C	**Green**	**3**	3	3	0	0	1	0	0	0	0	7
C	**Red**	**3**	0	2	0	0	0	0	0	0	0	2
C	**Blue**	**3**	0	0	0	0	0	0	1	0	0	1
C	**Brown**	**3**	0	0	0	0	0	0	0	0	0	0
C	**Orange**	**3**	0	0	0	0	0	0	0	0	0	0
E	**Red**	**3**	1	0	0	0	0	0	0	0	0	1
E	**Blue**	**3**	2	0	0	1	0	0	0	0	0	3
E	**Purple**	**3**	0	0	2	0	0	0	2	0	0	4
E	**Brown**	**3**	0	0	0	0	0	0	0	0	0	0
E	**Green**	**3**	0	0	0	0	0	0	0	0	0	0
E	**Orange**	**3**	0	0	0	0	0	0	0	0	0	0
B	**Blue**	**3**	1	0	0	0	0	0	0	0	0	1
B	**Brown**	**3**	1	0	0	0	0	0	0	0	0	1
B	**Purple**	**3**	1	0	0	0	1	0	1	0	0	3
B	**Green**	**3**	0	1	0	0	0	0	0	0	0	1
B	**Orange**	**3**	0	0	0	0	0	0	1	0	0	1
B	**Red**	**3**	0	0	0	0	0	0	0	0	1	1
D	**Blue**	**3**	0	0	0	0	0	0	0	0	0	0
D	**Brown**	**3**	0	0	0	0	0	0	0	0	0	0
D	**Green**	**3**	0	0	0	0	0	0	0	0	0	0
D	**Orange**	**3**	0	0	0	0	0	0	0	0	0	0
D	**Purple**	**3**	0	0	0	0	0	0	0	0	0	0
D	**Red**	**3**	0	0	0	0	0	0	0	0	0	0

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APPENDIX E

DEMOGRAPHIC SURVEY FORM

Name: _____
Rank/Rate: _____
Designator (Specialty): _____
Branch of Service: _____
Years of Service: _____
Leadership Experience:

( ) Command
( ) Department Head
( ) Division Officer
( ) Other: _____
( ) None

Team: _____
Postion: _____

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APPENDIX F

1. RATIONALE FOR CHANGING ROLES AND RESPONSIBILITIES FORM (AFTER EXPERIMENT 9)

RATIONALE FOR CHANGING ROLES AND RESPONSIBILITIES

Roles and/or responsibilities of a player will change if assets owned by that player change, or if task requirements change. Some roles are independent of assets owned, such as those of a coordinator, yet may change as the team adopts new task processing strategies.

In the accompanying ROLES AND RESPONSIBILITIES worksheet we are asking you to denote each *change* being made to *your* prior roles and responsibilities, the assets (if any) that are needed to support the changed role, and the major reason motivating/driving the change, by code (in cases of multiple rationale for one change, use a separate line for each). If *no changes* at all are made to any of your R&Rs, please provide a written justification.

Several rationales for change include, but are not necessarily limited to:

AU: IMPROVE EFFICIENCY IN ASSET UTILIZATION: To make better use of available assets for tasks processing.

BW: BALANCE WORKLOAD: To more equitably distribute task processing and/or asset management workload among players.

CM: ADD COORDINATION MECHANISMS: To provide a coordinator or integrator for one or more kinds of tasks. (Not Asset Transfer)

PC: ADJUST TO PLAYERS' CAPABILITIES: To take advantage of a player's skills and/or competencies.

RC: REDUCE COORDINATION DEMANDS: To reduce the amount of coordination required to perform tasks, e.g., organize around tasks.

SA: IMPROVE SITUATIONAL AWARENESS: To improve SA via (re)defining commanders' Area of Responsibility or Area of Regard.

SR: IMPROVE SPEED OF RESPONSE: To improve team responsiveness, especially for time-critical tasks.

UT: POSITION TEAM TO HANDLE UNANTICIPATED TASKS: To better accommodate unanticipated tasks/events, or surprise enemy tactics.

O: OTHER: You may have other reasons driving your change. If so, please indicate them on the reverse of the Roles & Responsibilities worksheet.

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

RED

TEAM:

	INITIAL ROLES and RESPONSIBILITIES – RED	ASSETS
(a)	Provide AAW defense theater-wide against enemy AAC, ACAP, CDL-missiles and SDG-fired exocets	F18A, SM2
(b)	Protect E2Cs	F18A, SM2
(c)	Provide support for all tasks that have an AAW requirement, including mission tasks, unanticipated tasks, combat S&R, etc.	F18A
(d)	Determine if possible hostile aircraft (APH) are hostile or not	F18A/sensor
(e)	Coordinate with ORANGE/SuWC as might be required to assist/protect MH53s and/or FABs	coord

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
F					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

BLUE

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - BLUE	ASSETS
(a)	Conduct all S&R operations theater-wide	HH60s
(b)	Obtain support from ORANGE/SuWC or RED/AWC as might be needed for any combat S&R tasks.	coord

	ROLES and RESPOSIBILITIES - PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 2				
	Planning Session 3				
F					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

BROWN

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - BROWN	ASSETS
(a)	Provide SOF support to all ground tasks in Areas A1, A2, B -- especially mission tasks	SOFs
(b)	Coordinate with GREEN/STRIKE to illuminate/designate targets and/or mount joint attacks as may be required in land areas A1, A2 and B	coord

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
F					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

ORANGE

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - ORANGE	ASSETS
(a)	Provide ASuW defense theater-wide against enemy SPT and SDG	FAB, HARP
(b)	Determine if possible hostile surface craft (SPH) are hostile or not	FAB/sensors
(c)	Provide support for all tasks that have an ASuW requirement, including mission tasks, unanticipated tasks, combat S&R, etc.	FAB
(d)	Responsible for all mine-clearing operations theater-wide	MH53s
(e)	Coordinate with RED/AWC as might be required to assist/protect MH53s and/or FABs	coord

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
F					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

GREEN

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - GREEN	ASSETS
(a)	Apply strike assets to process all tasks that include a STRIKE requirements -- especially mission tasks	F18S, TLAM
(b)	Destroy SAM sites north of 325 in areas A1, A2 and B, especially those that hinder ingress of F18S and UAV. Use F18S on mobile SAM sites	F18S, TLAM
(c)	Coordinate with BROWN/SOF and/or PURPLE/ISR as may be required for task illumination or joint attack	coord

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
F					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

PURPLE

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - PURPLE	ASSETS
(a)	Respond to all ISR tasks in a timely manner, including terrain mapping requirements and early detection/localization of SCUD missile launchers	UAVs
(b)	Illuminate SCUD launchers to allow attack by available strike ssets.	UAV/coord
(c)	Detect and illuminate CDLs and coordinate with GREEN/STRIKE to attack	UAV/coord
(d)	Discover SAM sites while avoiding having your UAVs shot down	UAVs

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
F					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

BLUE

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - BLUE	ASSETS
(a)	Conduct ISR operations in area A1 including mapping requests, locating SML, CDL and SAM sites;	UAV
(b)	Primary responsibility for mission tasks in Area A1 including NBW, BR, ABW; SML and SAM site prosecution; prosecution of any RGF, CDL, etc.	SOF, TLAM
(c)	Provide AAW defense using SM2 in an area ~ 100mi around own ship	SM2
(d)	Provide ASuW defense in an area ~ 60mi around own ship	FAB, HARP
(e)	Conduct S&R operations in an area ~ 70mi around own ship and in Area A1	HH60
(f)	Obtain additional STRIKE, ISR and AAW support from GREEN/CVN as needed.	coord
(g)	Coordinate with BROWN/DDGC on overlapping/adjacent coverage areas.	coord

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
D					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

BROWN

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - BROWN	ASSETS
(a)	Conduct ISR operations in area A2 including mapping requests, locating SML, CDL and SAM sites;	UAV
(b)	Primary responsibilty for mission tasks in Area A2 including C2-CTR, ABE, NBE; SML and SAM site prosecution; prosecution of any RGF, CDL, etc.	SOF, TLAM
(c)	Provide AAW defense using SM2 in an area ~ 100mi around own ship	SM2
(d)	Provide ASuW defense in an area ~ 60mi around own ship	FAB, HARP
(e)	Conduct S&R operations in an area ~ 70mi around own ship and in Area A2	HH60
(f)	Obtain additional STRIKE, ISR and AAW support from GREEN/CVN and PURPLE/FFG as needed.	coord
(g)	Coordinate with BLUE/DDGA and RED/CG on overlapping/adjacent coverage areas.	coord
(h)	Coordinate with ORANGE/DDGB on adjacent coverage areas A2 and B	coord

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
D					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

ORANGE

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - ORANGE	ASSETS
(a)	Conduct ISR operations in area B including mapping requests, locating SML, CDL and SAM sites;	UAV
(b)	Primary responsibility for mission tasks in Area B including PORT; SML and SAM site prosecution; prosecution of any RGF, CDL, etc.	SOF, TLAM
(c)	Provide AAW defense in an area ~ 100mi around own ship	SM2
(d)	Provide ASuW defense in an area ~ 60mi around own ship	FAB, HARP
(e)	Conduct S&R operations in an area ~ 70mi around own ship and in Area B	HH60
(f)	Obtain additional STRIKE, ISR support from PURPLE/FFG and CG/RED as needed.	coord
(g)	Obtain additional AAW support from PURPLE/FFG as needed.	coord
(h)	Coordinate with PURPLE/FFG and RED/CG on overlapping/adjacent coverage areas.	coord
(i)	Coordinate with BROWN/DDGC on adjacent coverage areas A2 and B	coord

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
D					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

GREEN

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - GREEN	ASSETS
(a)	Support BLUE/DDGA and BROWN/DDGC with F18S ground strike operations in areas A1 and A2, including mobile SAM sites (SA3).	F18S
(b)	Supported commander for mine clearing operations in an area extending 100mi from the North shore of country A. Coordinate with RED/CG on mine clearing	MH53
(c)	Conduct F18A air defense operations in an area extending 200mi North of countries A and B. Defend E2C. Coordinate AAW with BLUE/DDGA and BROWN/DDGC.	F18A
(d)	Provide local ASuW defense in an area ~ 40mi around own ship	FAB
(e)	Conduct S&R operations in an area ~ 70mi around own ship	HH60
(f)	Conduct ISR in the north of and along shoreline of Country A.	UAV
(g)	Support BLUE/DDGA and BROWN/DDGC in conducting ISR in areas A1 and A2.	UAV/coord

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
D					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

RED

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - RED	ASSETS
(a)	Supporting commander to BLUE/DDGA, BROWN/DDGC and ORANGE/DDGB for TLAM strike operations in areas A1, A2 and B, respectively.	TLAM
(b)	Supported commander for mine clearing operations in an area extending 100mi from the North shore of country B. Coordinate with PURPLE/FFG and GREEN/CVN.	MH53
(c)	Provide AAW defense using SM2 in an area ~ 100mi around own ship	SM2
(d)	Provide ASuW defense in an area ~ 60mi around own ship	FAB, HARP
(e)	Conduct S&R operations in an area ~ 70mi around own ship	HH60
(f)	Conduct ISR in the northern half of Country B and along north and east shorelines.	UAV
(g)	Support BROWN/DDGC and ORANGE/DDGB in conducting ISR in areas A2 and B	UAV/coord
(h)	Coordinate with BROWN/DDGC and ORANGE/DDGB on overlapping/adjacent coverage areas	coord

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
D					

Area A1: ground area western half of country A (from 0 to 125mi)
Area A2: ground area eastern half of country A (from 125 to 250mi)
Area B: entire ground area of country B (from 250 to 375mi)

PURPLE

TEAM:

	INITIAL ROLES and RESPONSIBILITIES - PURPLE	ASSETS
(a)	Support BROWN/DDGC and ORANGE/DDGB with F18S ground strike operations in areas A2 and B	F18S
(b)	Supported commander for mine clearing operations in an area extending 100mi from the East shore of country B. Coordinate with RED/CG on mine clearing.	MH53
(c)	Provide AAW defense using SM2 in an area ~ 100mi around own ship	SM2
(d)	Conduct F18A air defense operations in an area extending ~ 200mi East from the center of country B. Defend E2C. Coordinate AAW with ORANGE/DDGB, RED/CG.	F18A
(e)	Provide ASuW defense in an area ~ 60mi around own ship	FAB, HARP
(f)	Conduct S&R operations in an area ~ 70mi around own ship	HH60
(g)	Conduct ISR in the southern half and along shoreline of Country B.	UAV
(h)	Support ORANGE/DDGB in conducting ISR in area B.	UAV/coord
(i)	Coordinate with ORANGE/DDGB on overlapping/adjacent coverage areas.	coord

	ROLES and RESPOSIBILITIES – PLANNING SESSION 1	To	From	ASSET	RATIONALE (one only)
	Planning Session 1				
	Planning Session 2				
	Planning Session 3				
D					

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